Devoted to
TEXTILE
CHEMISTRY
BLEACHING
DYEING
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UGUST 26, 1946
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AMERICAN

DYESTUFF REPORTER

Write for 318-D.

What is 318-D?

Why, not just another color card, but *the* card showing the unequalled *Solophenyl Colors.*

Not an unlimited range it is true, for only the fastest-to-light direct colors carry the label *Solophenyl**. However, the range is adequate as many rayon and cotton mills have learned to their complete satisfaction.

Write Geigy for Color Card #318-D.

**Reg. U. S. Patent Office*

GEIGY COMPANY, INC.

89-91 BARCLAY STREET — NEW YORK — NEW YORK

Boston · Providence
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Geigy
Dyestuff Makers Since 1859

In Great Britain
The Geigy Co., Ltd.
National Buildings
Parsonage, Manchester

FICIAL PUBLICATION
of the
PROCEEDINGS
ERICAN ASSOCIATION
F TEXTILE CHEMISTS
AND COLORISTS

today's answer to better water repellent and stain resistant fabrics . . .

PARAMUL 115 Water Repellent, born of wartime needs, is a Cyanamid textile finish that imparts water repellency and stain resistance to fabrics for outer wear and equipment purposes.**

PARAMUL 115 IMPREGNATES THE FIBRES of a fabric with minute wax particles and aluminum salts, without any stiffening effects. It may be used with highly satisfactory results on cotton, rayon, linen and wool fabrics.

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EASILY AND ECONOMICALLY APPLIED—PARAMUL 115 is odorless and harmless to skin or fabrics. Try PARAMUL 115 today and find out how it can help you cash in on the highly profitable market for water repellent fabrics. The services of our technical staff and research laboratories are at your disposal in using this product to achieve the best results in imparting water repellency and stain resistance to *your* fabrics.

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Among Cyanamid Products for the Textile Industry Are . . .

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PARAMUL®* 115 Water Repellent, and other Specialties and Heavy Chemicals.

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DYESTUFFS • CHEMICALS • INTERMEDIATES

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VAT DYES OF THE DOW CHEMICAL COMPANY

The Onyxsans*

for

Softer Finish
•
Better Drape
•
Lasting Hand

THE ONYXSANS are cation active synthetic softening agents, easily applied to every kind of textiles. Their function is to impart softness, smoothness and drape to fabrics which would otherwise be coarse, harsh, rough and almost impossible to improve by chemical treatment. Extremely small amounts of the particular Onyxsan adapted to the finish and fabric involved bring about astonishing results.

Cationic Action Lasts – Through cation activity, the softness provided by Onyxsan is IN the yarn itself, as a result of thorough penetration, effective plasticizing and surface orientation of the Onyxsan molecule. On cotton and rayon the finish is *permanent*.

For Any Textile – An Onyxsan finish on any textile is much different from the results obtained by surface lubrication. On silk and wool, the touch is greatly improved, but the effect is not as lasting as it is on cotton and rayon.

Easy to Use – The Onyxsan suited to your requirements is used to give scoured goods a full dip in the pad, jig or quetsch. Or it can be applied in the last rinse on the dye beck. Goods are then dried in the normal manner.

No "Line" of Finishes Needed – There's no necessity of maintaining a stock of varied finishes when you use Onyxsan. A fine finish on any type of fabric from sheers to the heaviest constructions can be obtained by changing the method of application, the temperature and the amount of an Onyxsan used.

Stable and Uniform – The Onyxsans are uniform in chemical constitution. They do not deteriorate. Textiles finished with Onyxsan do not develop odors, do not show color alterations or mark-offs and do not stiffen in storage.

WRITE FOR A PLANT SCALE DEMONSTRATION!

*Patented

Other ONYX SPECIALTIES for Textile Finishing

•

Eternalure Resin Finishes
For improved body, stitch and snag resistance in nylon and other hosiery.

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For durable and effective treatment for water repellency on cotton, viscose, acetate and other fabrics.

Neutronyx 228
A non-ionic, non-foaming surface active detergent and emulsifying agent, widely used for scouring acetate, rayon and wool. Unusually valuable as auxiliary in simultaneous scouring and acid dyeing on wool.

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onyx CHEMICALS FOR DYEING AND FINISHING

American Dyestuff Reporter, Vol. 35, No. 17, August 26, 1946. Published every other Monday. Copyright 1946, by Howes Publishing Co., One Madison Ave., New York 10, N. Y. Domestic subscription, $5.00; Canadian, $6.00; Foreign, $6.00. Entered as second-class matter, Nov. 6, 1919, at the New York, N. Y., Post Office, under the act of March 3, 1879.

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for work clothes

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for sport clothes

INDANTHRENES

for couturiers' creations

Indanthrenes enhance the value of every fabric to which they are applied.

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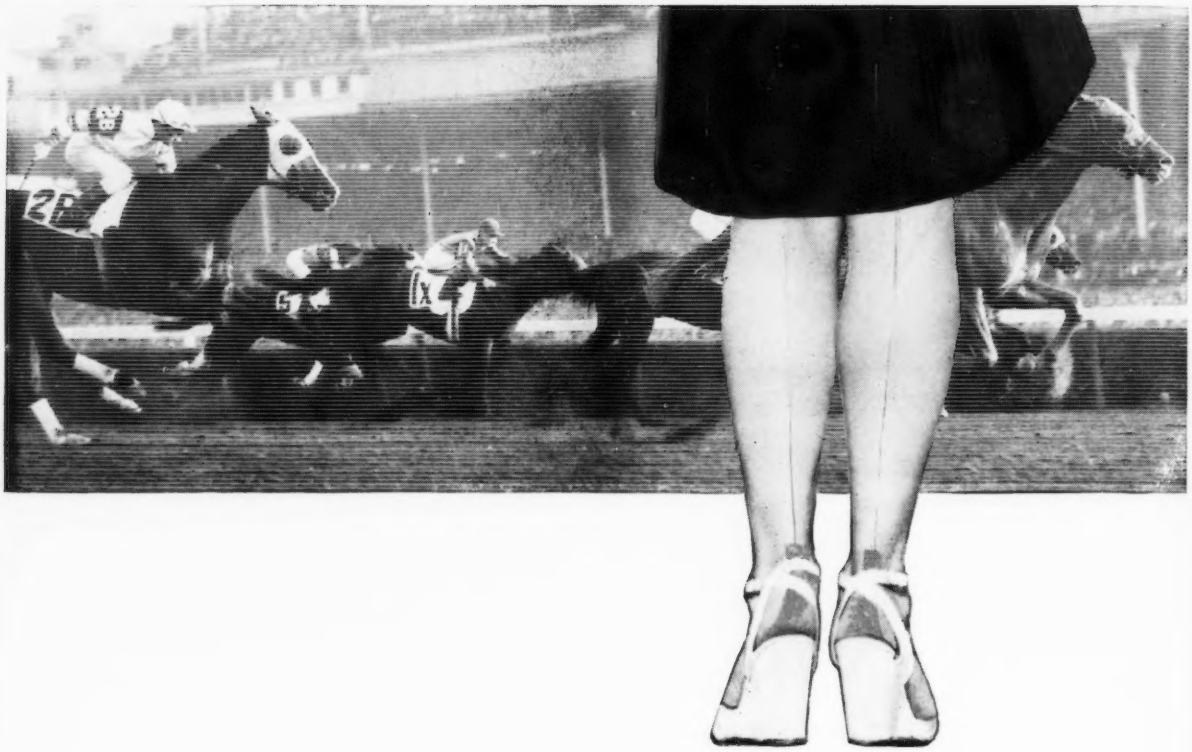

The FINISH is the Payoff!

In the race for sales, too, the finish is everything. Hosiery . . . and other textile products . . . must have that thoroughbred appearance to be "in the money."

For specialized chemicals—water repellents, mildew-proofings, etc.—as well as standard oils or finishing materials, you'll find that FANCOURT quality and personalized attention to your problems will help you take—and keep—the lead.

Try Resin B and Nyatex for beautifully finished nylons. Reduce handling damage; add sales appeal

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IT'S A SYNTHETIC ORGANIC DETERGENT! IT'S A SOAP POWDER!

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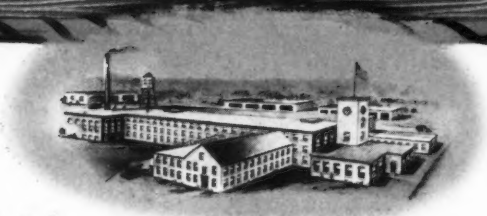
Try it Now. Ask for complete technical Data and a sample of ATCOSYN.



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Wm. Basser Prints a new "Crown" Tested Story!

No. 74 of a series from our files on the Crown* Tested Plan

It's a front page material . . . Bas-o-lin . . . this all American Viscose spun rayon fabric . . . and you'll be seeing it, hearing about it, plenty, in the months to come. Bylined by Wm. Basser Textile, Inc., every dye lot as it comes through, bears the additional assurance of the CROWN Tested Amber Light tag.

A Significant Lead

Fashion's current need for plenty of crisp, imaginative prints was lead enough for this firm's alert "nose for news." They developed a cloth that was supremely fit to print . . . then hustled it off to Shamokin Dye & Print Works, Inc., for a newsworthy series of colorful designs. To check its authenticity in action, they next consulted a veteran fabric reporter, CROWN Tested.

Amber Light Interview

Exacting CROWN Tested gave a glowing report on the new Basser fabric . . . Bas-o-lin. It won the Amber Light tag for hand washability. Dimensional restorability. Resistance to sunlight . . . perspiration . . . crocking . . . atmospheric fading. And its tensile strength and seam slippage were better than required. Thus another fine rayon fabric confidently prepared to take its place in the fashion headlines!

Look for a "Good Press"

You can look for, and win, enthusiastic acclaim when you launch your fabric under the CROWN Tested tag. Why not let us put this tag to work for you, as soon as possible?

NEW INFORMATIVE LABELING—CONSUMER SATISFACTION

Under the three tag system . . .

RED DISC for fabrics that can be dry cleaned only

GREEN DISC for washable fabrics

AMBER DISC for hand washable fabrics

*Reg. U. S. Pat. Off.

"Crown" Tested Rayon Fabric

A better way to buy rayon fabrics—This identification is awarded only to fabrics containing CROWN Rayon, after they have passed the CROWN Tests for serviceability. Samples of every dye lot of fabric have been tested against minimum requirements set and maintained by

AMERICAN VISCOSE CORPORATION

America's largest producer of rayon

Offices: 350 Fifth Ave., New York 1; Charlotte; Cleveland; Philadelphia; Providence; Washington; Wilmington.

"KEY TO PERFECT PRINTS"
Unlock the door to color-perfect prints with KELTEX, the modern algin thickening agent. It is ideally adaptable to the pad pigment method of vat dyeing—provides equally uniform results in machine and screen printing. KELTEX is your best guarantee of sharp, clean prints . . . cool, color-rich pastels.
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KELTEX is a product of Nature—always uniform—processed to produce a consistently exact result. Your formula never varies with KELTEX. Our expert Technical Department is at your service—without cost or obligation. Won't you consult us?
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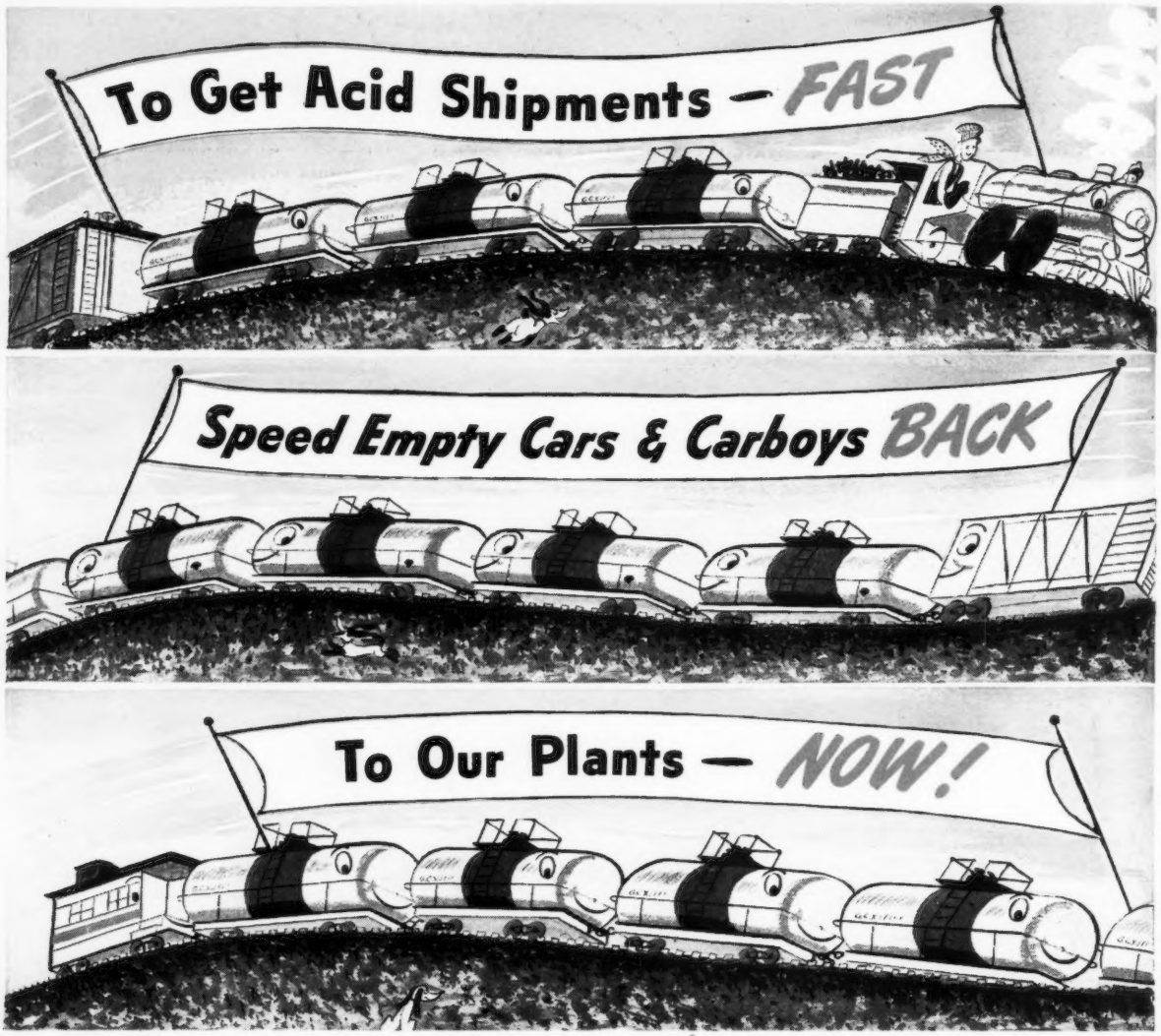

ONCE AGAIN it's full speed ahead for Industry and a tremendous pent-up demand for all basic chemicals—particularly acids—has to be met virtually overnight.

THAT IS WHY every tank car in General Chemical's vast fleet—as well as all other returnable containers—must be kept rolling to help Industry avoid delays, shortages, and stoppages.

TO KEEP a steady flow of acid shipments coming to your plant and others, cooperate this way ★

TANK CARS

- ★ **Unload Immediately**
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CARBOYS — DRUMS — CASES

- ★ **Empty Soon As Possible**
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BASIC CHEMICALS
GENERAL CHEMICAL COMPANY
FOR AMERICAN INDUSTRY

EASTMAN FAST YELLOW GLF

A Dyestuff for Cellulose Acetate Rayon and Nylon

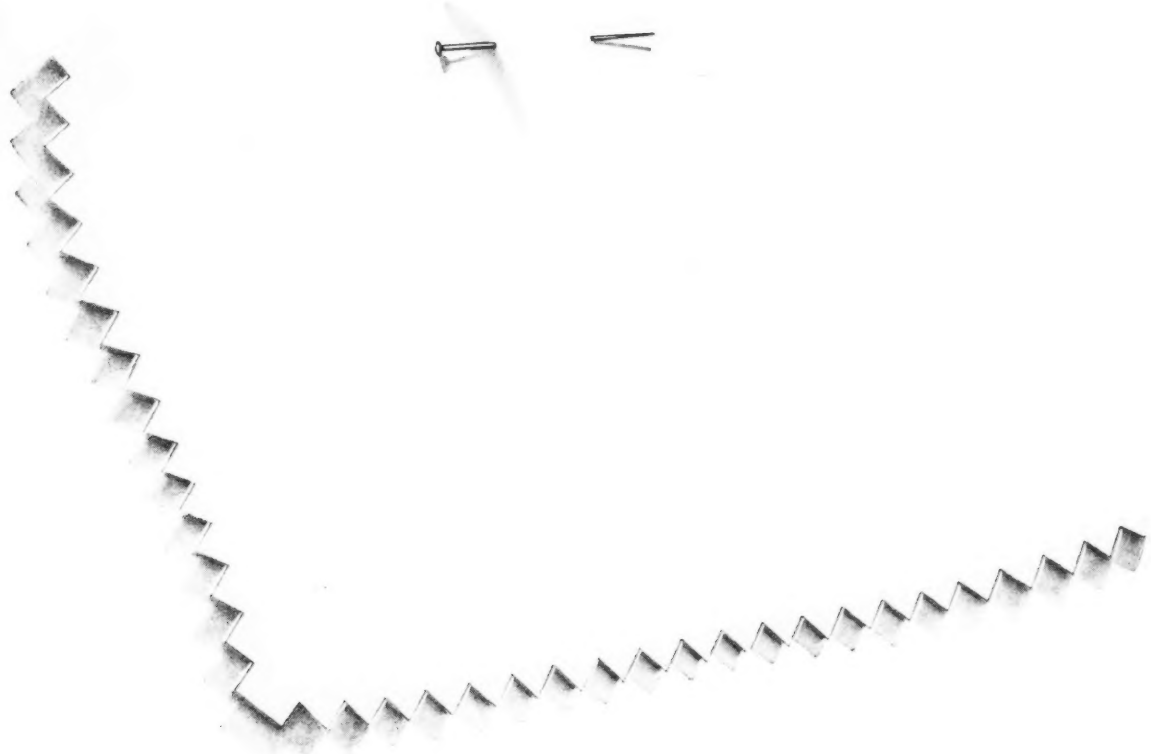
EASTMAN FAST YELLOW GLF, one of a line of dyestuffs with exceptional fastness to sunlight, produces bright shades of neutral yellow on acetate rayon and nylon. Dyed in pastel shades on delustered acetate rayon, twenty-five to forty hour light fastness results; dyed in heavy shades, light fastness approaches two hundred forty hours.

Eastman Fast Yellow GLF exhausts rapidly and levels exceptionally well over a temperature range of 130° F to 190° F, and it may be used on either jig or box. Since it leaves cotton and viscose white, it is suitable for cross dyeing. Eastman Fast Yellow GLF is highly recommended for the dyeing of drapery and other fabrics which require extreme fastness to light and gas fading.

Eastman Acetate Dyestuffs are available in a wide variety of useful colors for the dyeing of cellulose acetate rayon. Additional information on these dyes and their application to fibers and fabrics may be obtained from TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

Eastman

ACETATE DYESTUFFS



The

SILVER JUBILEE ISSUE of the American Dyestuff Reporter will be published on December second in commemoration of the twenty-fifth Anniversary of the AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS ★ The Annual Processing Review Number, which will contain the usual list of new dyestuffs and chemical auxiliaries, etc., will be published on December sixteenth. *However,* special emphasis will be placed upon the SILVER JUBILEE ISSUE.

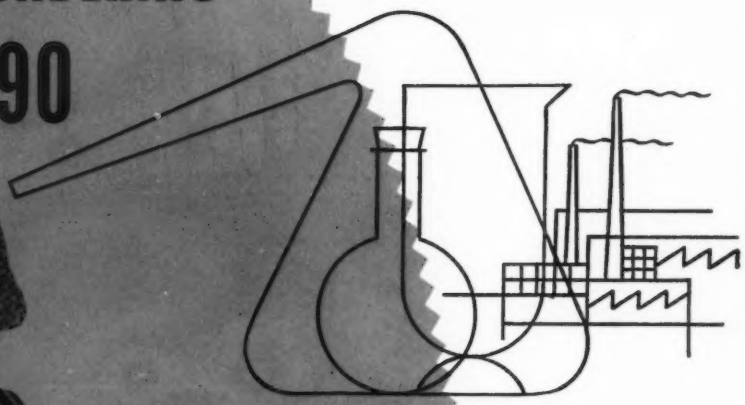
'The time has come, the Walrus said,
'To talk of many things:
Of shoes—and ships—and sealing-wax—
Of cabbages—and kings—
Yes and textiles, shoes, papers, cosmetics,
foods, biological stains and everywhere
that color is used, National Aniline
is most likely to be the favored supplier.
With the industry's oldest and broadest
background in solving color problems, we
welcome use of our unduplicated experience.
WHEREVER COLOR IS USED
National Aniline
DIVISION OF
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET NEW YORK 6, N. Y.
BOSTON · PROVIDENCE · PHILADELPHIA · CHICAGO · SAN FRANCISCO · CHARLOTTE
GREENSBORO · ATLANTA · NEW ORLEANS · CHATTANOOGA · PORTLAND, ORE. · TORONTO
NATIONAL DYES

Shoes by I. Miller

PATTERN FOR PRODUCING BRIGHTER PRINTS...

TO WITHSTAND LAUNDERING

VELVAMINE K90



This finishing and softening agent for all fabrics has a minimum effect on shade and light fastness of direct colors.

Prints are brighter and the finish is resistant to washing and dry-cleaning.

Especially recommended for starch and resin mixtures used in preparing materials for Sanforizing process, as it penetrates uniformly.

An excellent agent for rayon and cotton, used prior to spooling and knitting, where elasticity is desired.

REFINED PRODUCTS COMPANY

Lyndhurst • New Jersey

***Manufacturers of PERMA-CIDE, the approved, outstanding, mildew-proofing agent**

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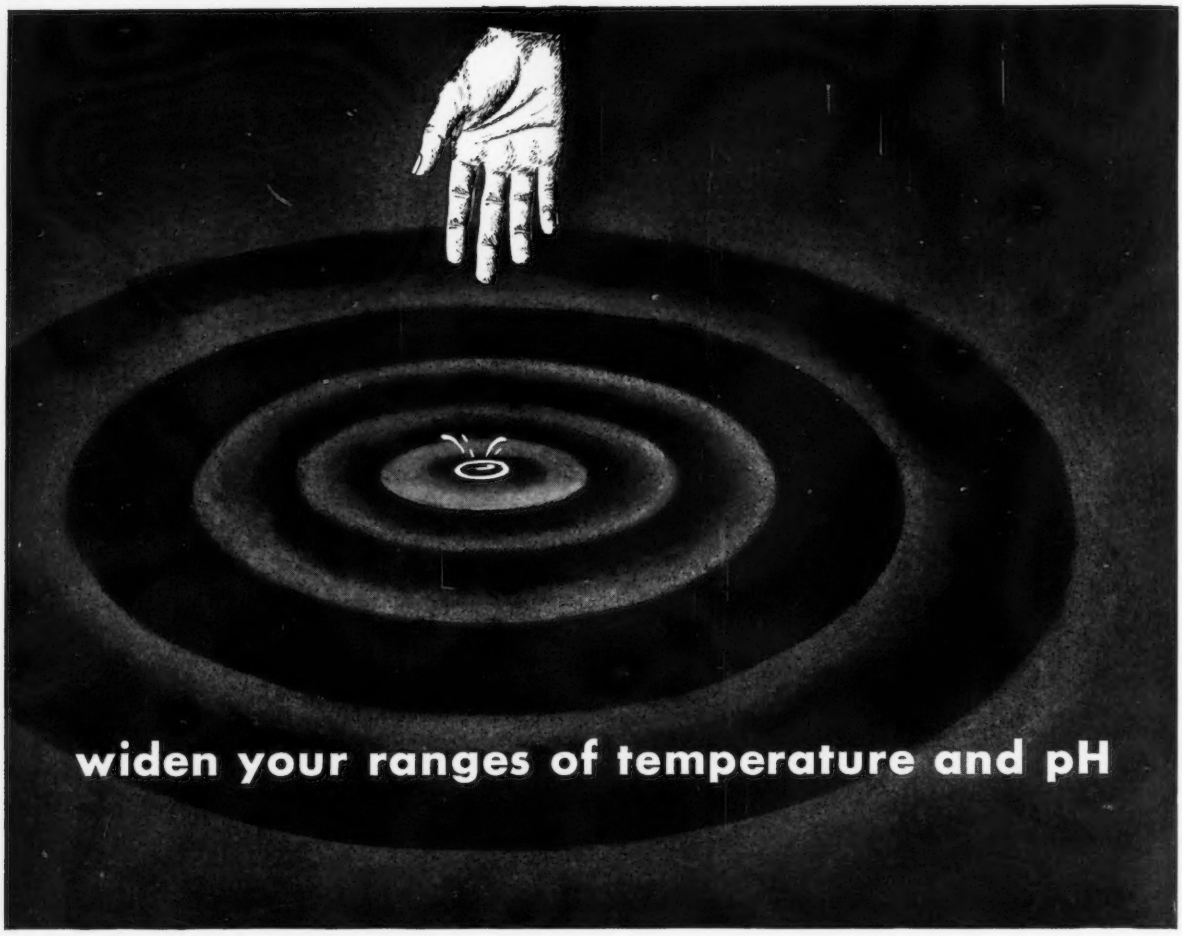
New England Representatives: E. L. LEGG, P. O. Box 597, Providence, R. I.
CLARENCE E. MOSS, 19 Wilson Ave., Rumford (16) R. I.

Canadian Selling Agents: Berkeley Products Canada, Ltd., 41 Hillcrest Avenue, St. Catharines, Ontario, Canada • Exporting Agent: Chem-Col Company, 82 Wall St., New York City



Choose DIASTAFOR de-sizing agent—Type L . . . helps eliminate problem lots

Drop a pebble into a pool—watch the circles widen. That gives you a good idea of the widened temperature and pH ranges of Diastafor—the all-purpose de-sizing agent.

Diastafor works efficiently in a wide range of temperatures and pH. Bleachers and dyers know what a great help this can be in de-sizing operations. Every batch of cloth with its own sizing formula creates a problem. Diastafor, with its wider ranges of effectiveness, helps eliminate problem lots.

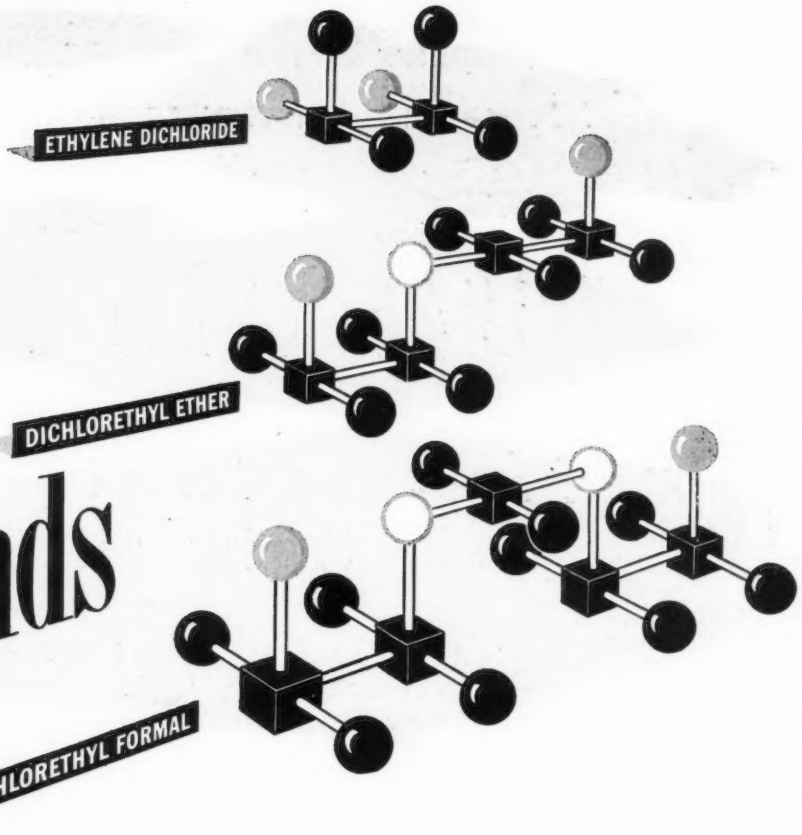
Diastafor de-sizing agent—Type L gives you a fine finish for cottons, rayons, or mixed goods. Dyeing is even and unshaded—no streaks, no blemishes. It is easy to use and trouble-free, even on the hardest lots you have to dye. It gives you results you can count on—yard after yard, mile after mile.

For 38 years Diastafor brand de-sizing agents have been leaders. They are as nearly foolproof as our years of experience can make them. You get more enzymes per dollar with Diastafor.

Diastafor brand de-sizing agents come in various types—one to meet every need. If you have a problem in de-sizing, let us help you. Our technical staff will be glad to suggest ways to solve your de-sizing problems quickly and economically. For further information, write to Standard Brands Incorporated, *Diastafor Division,* 595 Madison Avenue, New York 22, New York.

DIASTAFOR

A TRADE MARK OF STANDARD BRANDS



chlorine compounds

Industrial Solvents — Chemical Intermediates — Agricultural Fumigants

The molecules represented here are some of the chlorinated organic compounds that have been developed by Carbide and Carbon Chemicals Corporation to meet the needs of industry and agriculture.

Chlorine compounds are widely employed as cleaning compounds, pharmaceutical extractants, dewaxing agents for refining lubricating oils, and solvents in resin coatings and rubber cements. They are valuable to the textile industry in kier boiling and degumming.

Chlorine compounds are useful as general industrial fumigants and as agricultural soil fumigants for the control of insect pests.

As chemical intermediates, chlorine compounds are used in the manufacture of acids, amines, nitriles, phenol derivatives, pharmaceuticals, yellow pigments, resins, and oil-resistant rubbers.

For further information about these compounds, call or write our nearest office for the booklet, "Chlorine Compounds" (Form 4769).

These are the chlorine compounds we produce:

ETHYLENE DICHLORIDE
"CHLORASOL" FUMIGANT
PROPYLENE DICHLORIDE
BUTYL CHLORIDE
DICHLORETHYL ETHER
DICHLORISOPROPYL ETHER
DICHLORETHYL FORMAL
TRIGLYCOL DICHLORIDE
ETHYLENE CHLORHYDRIN
PROPYLENE CHLORHYDRIN
CHLORACETOACETANILIDE

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

UCC

30 East 42nd Street, New York 17, N. Y.
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SYNTHETIC ORGANIC CHEMICALS

"Chlorasol" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

A message to suppliers of the Textile Wet Processing Industry re:

1946 YEAR BOOK

of the

American Association of Textile Chemists and Colorists

Work on the preparation of the 1946 Year Book of the American Association of Textile Chemists and Colorists is now under way.

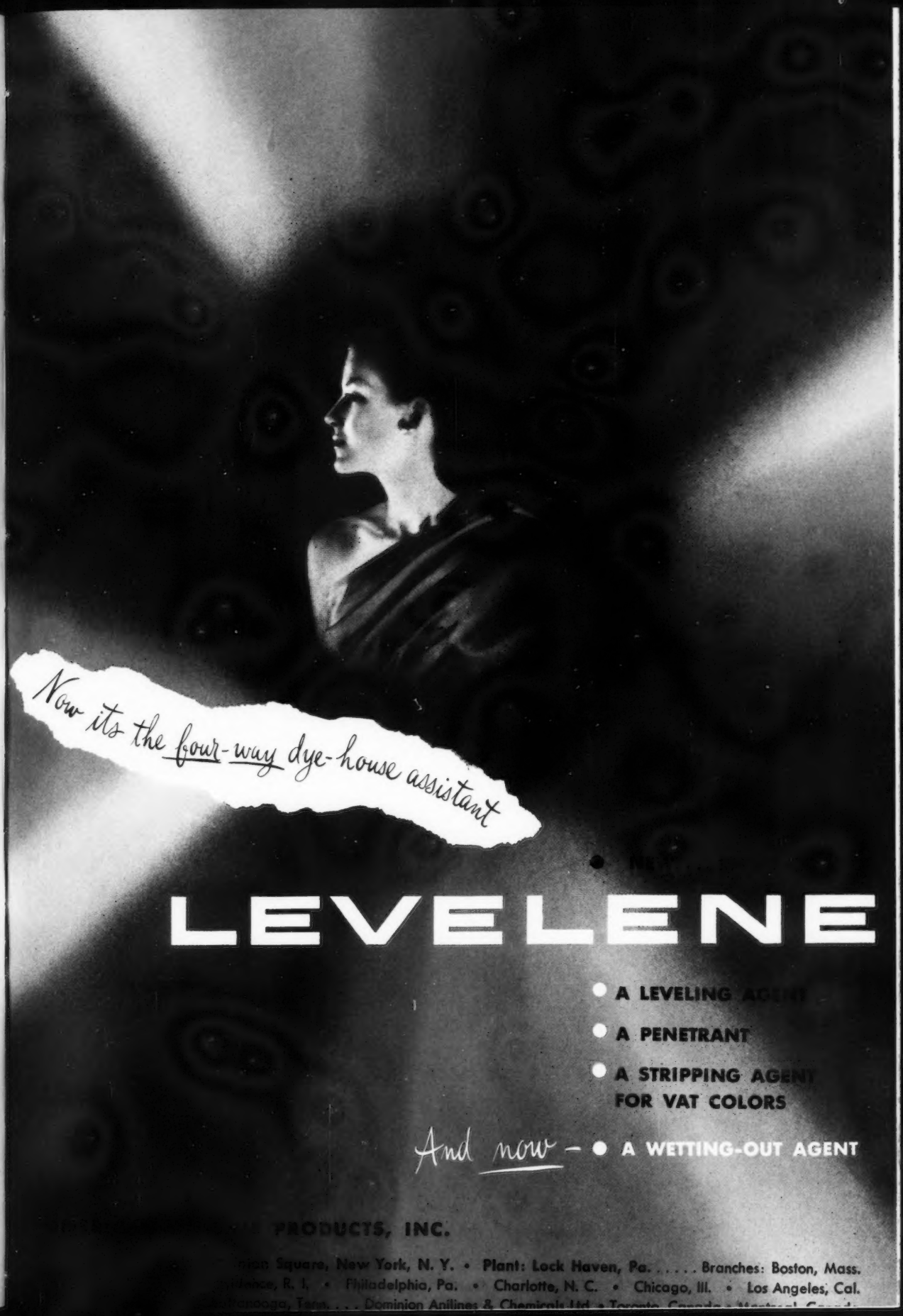
A great majority of the approximately 800 pages which comprise this volume are devoted to technical information such as standard testing methods for various fastness requirements, lists of dyestuffs, textile chemical specialties, etc. Because of this fact the book is a standard reference work used almost daily in practically every textile laboratory and dyehouse in the country.

An advertising message in its pages will reach those individuals chiefly concerned with the purchasing of textile wet processing requirements. This message will reach them, not only once, but constantly throughout the year.

Advertising rates, for an anticipated circulation of over 5500, are only $125.00 per page and $75.00 per half page.

The Howes Publishing Company acts as agents for the Association in the publication of the volume but has no share in its finances. Inquiries regarding advertising space should be directed to them at:

One Madison Avenue, New York 10, N. Y.


Now its the four-way dye-house assistant
LEVELENE
A LEVELING AGENT
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A STRIPPING AGENT FOR VAT COLORS
And now — A WETTING-OUT AGENT
PRODUCTS, INC.
Square, New York, N. Y. • Plant: Lock Haven, Pa. . . . . Branches: Boston, Mass.
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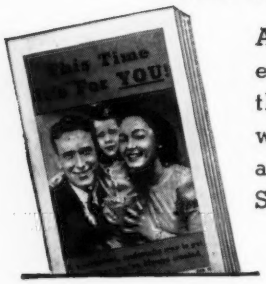
Dominion Anilines & Chemicals Ltd.

helps to a healthy future

- **FOR YOU**
- **FOR YOUR COMPANY**
- **FOR AMERICA**

THIS TIME IT'S FOR YOU—



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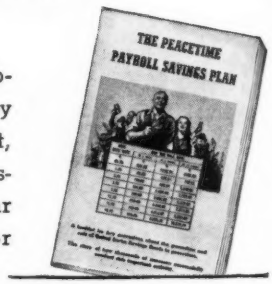
The person appointed Official U. S. Savings Bond Officer for his organization is entitled to display this two-color certificate of identification and the Treasury's appreciation of his service.

OFFICIAL COMMENDATION—

A red-white-and-blue certificate of commendation by the U. S. Treasury for every company operating the payroll savings plan. You can display it proudly, and it will remind people of the importance of the program.

THE PEACETIME PAYROLL SAVINGS PLAN—



A booklet, published for key executives by the Treasury Department, containing helpful suggestions on the conduct of your payroll savings plan for U.S. Savings Bonds.

Are You Using These Booklets?

If you're not already using these helps to a healthy future, get in touch with your State Director of the Treasury Department Savings Bonds Division. And by all means keep up your payroll savings plan. It's a powerful weapon for the maintenance of a strong, secure economy — today and tomorrow!

The Treasury Department acknowledges with appreciation the publication of this message by

AMERICAN DYESTUFF REPORTER

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and the Advertising Council

SULFRAMIN

A SYNTHETIC ORGANIC DETERGENT; EFFECTIVE EVEN IN DILUTIONS OF *1 to 10,000*

OF SPECIAL INTEREST TO THE TEXTILE INDUSTRY...

SULFRAMIN DT and SULFRAMIN LW (Powder) Powerful synthetic detergents and foaming agents unsurpassed wherever hard water presents a problem. LW has a higher lauric content, and consequently is preferred when used in water colder than 50° C. Textile processors and manufacturers of dyeing assistants, use either type, depending upon the temperature of the solution.

SULFRAMIN DH (Paste) A concentrated, slightly alkaline detergent offering great money value as an all around boil-off compound. It is adaptable to the manufacture of various scouring, boiling-off and dyeing assistants; and is usable under any water conditions.

SULFRAMIN DR A neutral compound of high wetting and scouring qualities, having the appearance of a clear, sulphonated oil. It is immediately soluble in hot or cold water, and is therefore an ideal dyeing assistant. It can be employed advantageously as a straight product or in conjunction with various sulphonated oils.

SULFRAMIN DHL A clear, leveling agent having the appearance of a sulphonated oil; and suitable for solving your most vexing dyeing problems. It has powerful leveling and penetrating qualities, and assures complete satisfaction in the processing of rayon and acetate fabrics.

SULFRAMIN DT (Paste) A strictly neutral, synthetic detergent, with good wetting qualities and complete resistance to hard water. Manufacturers of dyeing assistants, and textile processors, use it principally in scouring and dyeing preparations. Being neutral, DT is particularly useful in alkaline solutions.

SULFRAMIN N This is a non-foaming wetting agent, having the appearance of a heavy paste. Although of radically different chemical structure, Sulframin N shares many of the advantages inherent in many of the other Sulframin products. Its strongest feature is its complete immunity to the effects of inorganic acids and alkalies. Consequently, it is preferred in the processing of wool, such as in carbonizing, in dyeing, etc. Not only is Sulframin N an outstanding leveling agent; it can also be safely employed with any amount of alkali.

ULTRA Chemical WORKS

ULTRA CHEMICAL WORKS, Inc.

- PATERSON, N. J.
- CHICAGO, ILL.
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Indigosols
for Pink Shades of Good Fastness

INDIGOSOL Pink IR EXT, and
INDIGOSOL Scarlet HB

are two products in this soluble vat color group which are unexcelled for the production of pink shades of good fastness. They are unequalled, in the fast color group, for ease of application, clearness of tone and the solidity of color in any depth. They can be printed, padded, or dyed on any textile fibre.

All INDIGOSOLS are readily soluble, easily developed and economical to use.

Pharmasols
for Bright Reds and Scarlets

PHARMASOL Scarlet RR Conc.
PHARMASOL Scarlet SNN
PHARMASOL Red GNBS
PHARMASOL Red RN and
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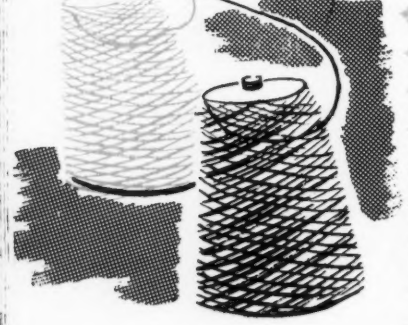

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VOLUME 35 AUGUST 26, 1946 NUMBER 17

The Dyeing of Direct Dyes on Cotton*

D. R. LEMIN, E. J. VICKERS and T. VICKERSTAFF

SUMMARY

Rate-of-dyeing measurements have been carried out on over fifty direct cotton dyes dyed on cotton in two liquor lengths and with three salt concentrations. The results are expressed in terms of the time of half-dyeing and the equilibrium exhaustion.

The value of the results in predicting the dyeing behavior of binary combinations of dyes has been critically examined. It is shown that in approximately one in three cases, the course of dyeing is not that which would be predicted from the rate-of-dyeing measurements on the individual components, whilst the prediction of truly compatible mixtures is even less successful. From this it is concluded that rate-of-dyeing data on direct dyes are of little practical value.

It is suggested that the rate of migration of direct dyes is of more importance than the rate of dyeing, and measurements of the migration rate and its variation with salt and dye concentrations have been made. The controllability of the dyes by salt is also highly important in practice, and the dyebath exhaustion produced by the addition of salt has been measured over a wide range of salt concentrations for all the dyes. A method of defining salt controllability is developed.

On the basis of the rate of migration and salt controllability, a system of classification of the direct dyes is derived which provides some indication of the best practical method of application.

Introduction

THE individuality of direct cotton dyes in the dyeing operation has been repeatedly stressed by Whittaker[1], and is now fully appreciated by both dyers and dye manufacturers. In the case of viscose rayon, the work of Boulton and of Neale has shown that the rate of dyeing of direct dyes may vary more than a thousandfold, whilst the salt sensitivity and temperature sensitivity also vary within wide limits. These variations have been studied in great detail, with beneficial effects on the understanding of the practical dyeing problems with this fiber. In view of this known behavior and its obvious importance in the dyeing of cotton, it is surprising, as Boulton and Morton have pointed out[2], that the dyeing of the natural fibers, e.g. cotton, linen and ramie, has not been investigated in the same detail.

Some publications on the rate of dyeing of cotton have recently appeared, but it seems to us that they, and indeed many of the published papers on rayon dyeing, lack a really critical appraisal of the value of the data which they contain, and our aim in the present investigation is to provide the dyer with information on the dyeing properties of a further set of dyes, and at the same time to analyze the practical utility of the data critically and to test the theoretical predictions by actual dyeing trials.

Interaction of Dyes in Admixture

Before proceeding to describe the results obtained in the present investigation, it may be well to indicate the manner in which previous investigations on dyeing behavior are felt to be inadequate. In all published investigations the dyeing properties of single dyes have been measured. In practice, the use of mixtures of dyes to obtain specific shades is almost universal, and the results obtained for the behavior of individual dyes have been used in the past to select those dyes which have similar dyeing properties for use in mixtures. The assumption which underlies this selection is that *the dyeing properties of one dye are not modified when a second dye is present in the same dyebath.* This assumption is obviously of the highest importance, and in the past has been almost completely ignored or dealt with most inadequately. Only in a recent paper by Boulton[3] is any attempt made to explore its validity. Boulton concluded from his experiments that the assumption is valid and that rate-of-dyeing measurements made on individual dyes are a guide to their behavior in mixtures. On the other hand, there is a considerable volume of evidence pointing to the contrary conclusion. Neale and Stringfellow[4] showed that the spectra of direct cotton dyes are altered in many cases when the dyes are mixed, indicating that interaction occurs between the dyes in solution.

* Reprinted from the Journal of the Society of Dyers and Colourists, May, 1946.

Further, they showed that when mixtures are dyed on to cotton, the absorption of at least one component is reduced markedly below the value which would be anticipated merely on the grounds of competition of the two dyes for the cellulose. Interference was found to increase with decreasing temperature. With regard to rate of dyeing, however, the rate of all those dyes tested was decreased when they were used in mixtures, and times of half-dyeing up to twice as long as normal were obtained. Neale and Stringfellow argued that this decrease in rate is negligible as compared with the range of a thousandfold between individual dyes.

This evidence, obtained with a limited range of dyes on Cellophane, does suggest that direct dyes interact during dyeing, and similar, but more pronounced, effects have been observed in these laboratories in the dyeing of nylon with Solacet or acid dyes; on the other hand, little, or no interaction appears to take place in the dyeing of dispersed dyes on the same fiber.

Such evidence casts doubt upon the validity of the assumption that the rate of dyeing of individual dyes may be used as a guide to the selection of compatible mixtures, and it is clearly important to decide the extent to which this interaction occurs over a wide range of dyes. If interaction is very common, then the value of rate-of-dyeing data for the purpose of mixture selection is greatly reduced. The first portion of the present work was therefore carried out in order to investigate this point and may be divided into two parts, the first of which consists in obtaining data upon the dyeing properties of a very wide range of dyes, whilst the second consists of a study of the applicability of the data to practical problems. Following this, a study of other dyeing properties of direct dyes was also carried out.

Rate of Dyeing—Methods of Measurement

In spite of the numerous measurements of rate of dyeing which have been made in the past, there remains considerable uncertainty as to the best method of assessing this factor. As regards the method of measurement, there is little to debate. In some way the quantity of dye on the fiber (or in the dyebath) must be estimated at intervals from the beginning to the end of the dyeing operation. In the past this has been done either by colorimetric examination of samples of the dyeliquor or of extracts of the dyed material, taken at intervals, or by visual examination of patterns dyed for increasing lengths of time, comparisons being made with dyeings of various depths of shade carried out for a normal length of time. There can be little doubt that the first two methods are much superior, for the third method does not yield any absolute measurement of the exhaustion of the dyebath. Accordingly, colorimetric estimation of the dyebath has been used throughout the present work.

As the result of such measurements, curves showing the variation of exhaustion with time can be drawn, as shown in Fig. 1, and such curves give an immediate and clear picture of the rate of dyeing of the particular dyes under the conditions used.

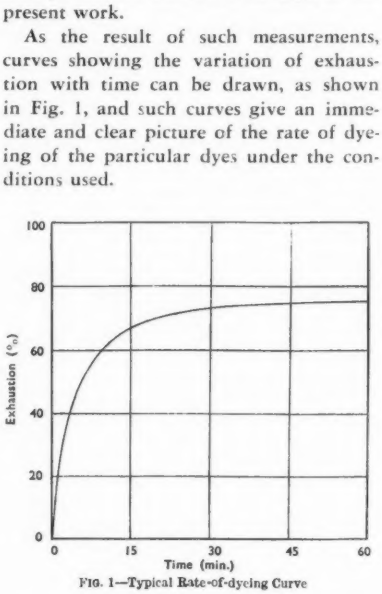


FIG. 1—Typical Rate-of-dyeing Curve

In comparing the properties of a number of dyes, however, the use of curves becomes very inconvenient and the need for a concise numerical expression of rate is strongly felt. It is in the methods used to classify rate curves and in the experimental conditions of measurement which are inherent in these methods, that variations exist and confusion arises.

Theoretically, a curve such as that shown in Fig. 1 can be analyzed into two functions, viz. the degree of exhaustion at equilibrium and the time required to attain that equilibrium. Since this latter time is difficult to determine with any precision owing to the very gradual approach to equilibrium, it is much more convenient to determine the time required for the dyebath to exhaust half as far as it will at equilibrium. This time may be termed "time of half-dyeing" and can be applied to any dyeing operation irrespective of the conditions used. This half-dyeing time may be considered as a measure of the rate of dyeing and the words are so used in the present communication. The limitations of this interpretation should be carefully considered. Time of half-dyeing is a measure of the overall dyeing speed and not the speed at any particular moment. The instantaneous rate of dyeing is given by the slope of the tangent to the curve at any time and varies continuously throughout the dyeing process, becoming slower as equilibrium is approached until finally it becomes zero. This measure of rate is an indication of the weight of dye going on to the fiber per minute, and in some cases is of greater practical significance than the overall rate. Confusion is also caused by the indiscriminate use of the words "rate of dyeing" to cover effects due more to differences in equilibrium exhaustion, as shown in Fig. 2.

In these two curves the dyeing process has not attained equilibrium after the

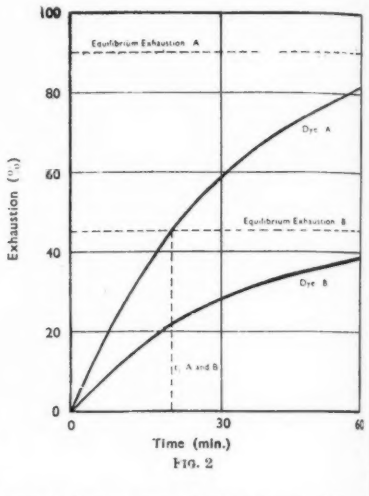


FIG. 2

normal dyeing period of 1 hr., and it is difficult at this stage to assess what the equilibrium values will be, particularly with the lower curve. The dyer would probably speak of B as having a lower rate of dyeing than A, and yet if dyeing be continued until the equilibrium point is reached it will be found that the only difference between A and B in this particular case is that the equilibrium value of the one is twice that of the other, the values for the time of half-dyeing being identical. From the practical point of view the effect is the same as would be produced purely by a difference in rate, and these curves, which show the course of the dyeing process in the first hour, may suffice to explain differences in dyeing properties, but it will be clear from this discussion that the two factors, viz. time of half-dyeing and equilibrium exhaustion, must both be taken into consideration in any attempt to predict dyeing behavior.

With regard to the conditions under which dyeing rate is to be determined, there is a great diversity of opinion. The number of variables must be limited as far as possible, and so there is general agreement that the temperature and salt concentration should be maintained constant throughout the dyeing operation and not increased gradually as is frequently the case in practice. The effect of these variables should be studied separately, if required. As regards the liquor length and salt concentration to be employed, however, there is no agreement and, in gen-

eral, workers in this field can be divided into two groups, one group consisting of those who wish to measure rate under conditions approaching as nearly as possible to large-scale practice, whilst in the other group are those who wish to employ conditions such that the rate of dyeing may be correlated with speed of diffusion of the dye into cellulose. If the concentration of dye in the dyebath can be kept constant throughout the dyeing operation, then the surface layer of each individual filament is in equilibrium with the dyebath and the overall rate of dyeing depends on the speed at which dye diffuses from this surface layer into the cellulose. Such conditions may be attained by dyeing a small quantity of fiber in a very large volume of liquor so that the quantity of dye absorbed by the fiber scarcely affects the dye concentration in the bath, and under these conditions the observed rate is a measure of speed of diffusion of dye inside the fiber. This speed will depend upon both the particle size of the dye and its affinity for cellulose, assuming dyeing to take place partially by step-wise diffusion along canals into the fiber. The greater the affinity of the dye for the fiber, the slower the rate of penetration, and the smaller the particle size, the quicker the penetration. Boulton has attempted to simplify the interpretation by making measurements in dyebaths of normal liquor length, but containing for each dye that amount of salt which will produce only 50 per cent exhaustion at equilibrium. Under these conditions the dyebath concentration of dye is substantially constant throughout the dyeing operation, and at the same time the affinity of different dyes for the fiber is made the same, as shown by the fact that the final exhaustion is 50 per cent in all cases. Consequently, under these special conditions, the rate of dyeing is a direct indication of the relative particle sizes of different dyes in the cellulose, and this method represents a very simple and elegant method of assessing the property. The significance of the results is discussed later.

In the present instance it was decided at the outset to measure dyeing rate under conditions approaching closely to those used in practice, as it appeared at first sight that such results would be more suited to the selection of practically compatible dyeing mixtures than the results of the alternative methods. Accordingly, dyeings were carried out in the two liquor lengths, viz. 5 : 1, which corresponds to practical conditions encountered in pack dyeing, and 60 : 1, which is rather a high liquor length corresponding roughly to winch dyeing. Additional reasons influencing the choice of the 60 : 1 liquor-goods ratio were the availability of an automatic dyeing machine of this liquor length, and the wider range of exhaustion which can be produced by the addition of salt in a long liquor.

In order to investigate the effect of salt on dyeing rate, three separate dyeings were carried out on each dye in the two liquor lengths, using additions of 0 per cent, 1 per cent and 3 per cent of calcined Glauber's salt in the 5 : 1 liquor experiment and 0 per cent, 8 per cent and 16 per cent of calcined Glauber's salt in the 60 : 1 liquor experiment. More detailed information on the effect of salt on exhaustion was obtained in separate experiments outlined later.

The temperature of dyeing was maintained constant at 90° C. throughout.

Experimental

In preliminary experiments using the longer liquor length, dyeings were carried out in the apparatus illustrated in Fig. 3.

The dyeing vessel consisted of a 2 l. round-bottom, bolt-head flask fitted with a reflux air condenser and tube dipping to the bottom of the flask so that samples of dyeliquor could be sucked out into the test-tube as indicated in the diagram. The dyeliquor (1,200 c.c.) was placed in a flask and the whole immersed in a thermostat at 92° C. until the liquor attained the required temperature. Cotton (20 g. of 2/30s bleached unmercerized cotton yarn) in loose hank form was next dropped into the dyeliquor and the flask shaken for a short time. It was then allowed to remain with little or no shaking for the rest of the dyeing period and samples of liquor were removed at intervals. These samples were diluted to contain 25 per cent pyridine and the dye content was estimated on a photoelectric absorptiometer. A number of dyeings were carried out in this way by two operators using what was apparently the same technique of shaking and general procedure. The points obtained were consistent and yielded a smooth curve for each dye when exhaustion was plotted against time, yet when the same dyes were tested by these two different operators the curves were widely different, in spite of the fact that each operator watched the other and could detect no difference in procedure. The cause of these discrepancies was not fully investigated, but it seems most probable that it was due to differences in the degree of agitation, for Hanson, Neale and Stringfellow[1] have shown this to be a most important factor in the dyeing of cotton. Variations in the time of preheating the dyebath before commencing the dyeing operation were shown to have a small

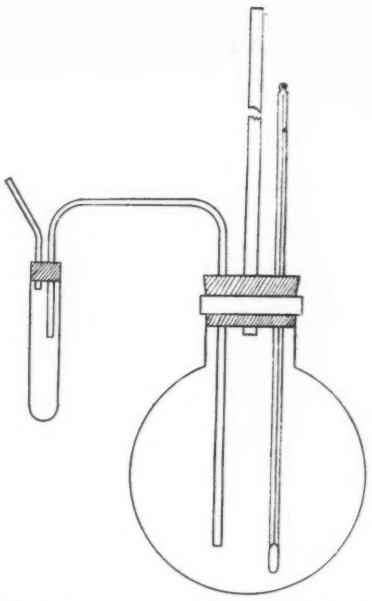


FIG. 3—Diagram of Apparatus for Dyeing in 60 Vol.

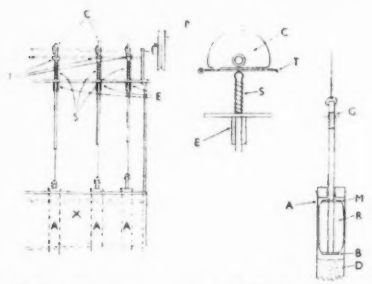
consistent effect on rate, but the magnitude was negligible as compared with the gross differences between operators. In view of the limited range of dyeing rates observed on cotton, variations of this magnitude cannot be tolerated, and it was therefore decided that in any dyeing operation on cotton the rate of circulation of the dyeliquor and the degree of agitation would have to be completely standardized in order to obtain reproducible results. The only reasonable solution to this problem is the use of mechanical agitation and, accordingly, two pieces of specialized apparatus were constructed for determination of rate of dyeing in 5 : 1 and 60 : 1 liquor lengths. These are described below.

5 : 1 *Liquor-Goods Ratio Determination*—A diagram of the apparatus used is shown in Fig. 4.

A roll of cotton material* weighing 2 g. and 2 in. approx. in width is wrapped loosely round a cop spindle, being held in position between a rubber ring at the bottom and a metal strip inserted crosswise through the spindle about 2.5 in. from the base. This is placed in a test-tube holding 10 c.c. of dyeliquor, and the whole immersed in a thermostat at 90° C. The top of the spindle passes through a glass tube in the rubber bung closing the mouth of the test-tube, permitting free working of the spindle without leaving much space for the evaporation of dyeliquor. During the dyeing process

* Cotton casement cloth was used in this series of experiments, but in all subsequent experiments and in all dip tests the material used was cotton limbric.

the material unrolls to some extent, resulting in better penetration of the fibers and also acting as a kind of piston in the tube. Agitation is obtained by connecting the top of the cop spindle by a



A Test-tube
B Rubber buffer
C Cam
D Dyeliquor
E Guides
G Rubber bung to prevent evaporation
M Metal strip
P Driving shaft and pulley
R Roll of material
S Spring
T Tappet
X Thermostat

FIG. 4—Apparatus for Measuring Rate of Dyeing in 5 Vol.

movable clip and rod to a plunger operated by means of a spring and cam. During the preliminary heating the material is held clear of the dyeliquor by means of two prongs engaging the collar of the cop spindle. When the support is removed, the spindle and material drop into the dyeliquor and are then raised and lowered by each revolution of the cam. The camshaft is driven at 70 r.p.m.

Individual dyeings were carried out for 1.5, 3, 7.5, 15, 30, and 60 min., and the exhaust dyebath, after suitable dilution with 50 per cent aqueous pyridine, was estimated colorimetrically on an absorptiometer, comparisons being made against a sample of the initial dyebath prepared at the same time.

As already mentioned, the speed of agitation was 70 r.p.m., and it was found that increases in the rate of agitation beyond this point had very little effect on the rate of dyeing. Results obtained with Durazol Fast Blue RS are given in Table I.

TABLE I
The Effect of Agitation on Speed of Dyeing of Cotton Casement Material

Speed of Agitation (r.p.m.)	Dye on Fibre (%)		
	1·5 min.	7·5 min.	20 min.
70	32	53	62
100	33	53	63

In order to investigate the accuracy and reproducibility of the results obtained with the apparatus, the rate-of-dyeing curve of one dye, viz. Durazol Fast Blue G 200, in a 1 per cent shade with no salt at 90° C., was determined three times by one observer and twice by a second observer. The results are given in Table II.

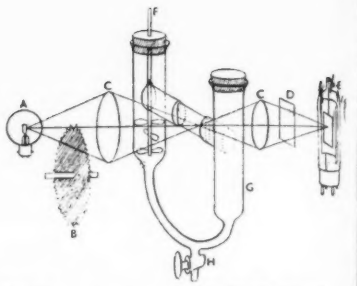
A statistical analysis of these results shows that there is no definite evidence that the error of any one point is related to the actual quantity of dye on the fiber. Hence the standard error may be calculated to be 1.8 per cent actual. By applying the technique of analysis of variance to Table II, it is concluded that there is a significant tendency for different curves to be distinct, i.e. one curve to lie bodily above another. In other words there is a significant dyeing error apart from errors in the determination of the dye content. Thus, the standard error of any given point is only 1.4 per cent actual in relation to its own particular curve, although it is 1.8 per cent in relation to the mean of the five curves. This may arise from slight temperature differences at the time of dyeing between each set of results, or more probably from differences in the state of aggregation of the dye solutions from which the dyebaths were prepared, or again from variations in the time of preheating. It is considered that the accuracy indicated by these results is quite adequate for all technical purposes and that the method gives reproducible results. Using this apparatus, rate-of-dyeing curves were determined with 56 direct cotton dyes. The concentrated brands were used where available in order to study the behavior of the comparatively salt-free dyes, which is of practical interest in dyeing in short liquors owing to the greater degree of control of exhaustion possible by the addition of salt. The percentage depths of shade of the different dyes were chosen to give approximately equal tinctorial strength on dyeing by the standard dyeing method given in the I.C.I. Chlorazol and Durazol Pattern Card No. 252/359. The cotton material used was casement cloth, and an addition of calcined Glauber's salt (giving no loss in weight on ignition) was employed in quantities approaching those used in practice; dyeings were carried out with 0 per cent, 1 per cent and 3 per cent additions of this salt.

TABLE II
Rate of Dyeing of Durazol Fast Blue G 200 on Cotton Casement Material
Accuracy of Method

Time (min.)	Dye on Fibre (%) Observer A			Observer B		Range (actual)	Dye on Fibre (mean %)	Range as % of Dye on Fibre
1·5	38·2	37·4	39·5	38·5	38·0	2·1	38·3	5·4
3	45·0	45·5	43·7	46·5	47·0	3·3	45·7	7·2
7·5	57·3	59·2	54·3	55·0	58·6	5·0	56·8	8·8
15	66·5	66·3	61·2	62·9	66·9	5·7	64·5	8·8
30	70·0	72·4	71·6	68·6	71·2	3·8	70·7	5·4
60	74·0	76·2	73·7	73·9	78·7	5·0	75·3	6·6
					Mean:	4·15	58·6	7·0

60 : 1 *Liquor-Goods Ratio Determinations*—The rate-of-dyeing measurements using this liquor-goods ratio were carried out in an automatic apparatus shown diagrammatically in Fig. 5.

The apparatus is described fully elsewhere[7], but a brief description is given here for covenience. The dyebath consists of a U-tube fitted with a horizontal cross-arm connecting the limbs near the top. In one limb of the tube is an electrically driven propeller which forces the



A Lamp
B Interrupter disc
C Lens
D Colour filter
E Photoelectric cell
F Stirrer
G Dyevessel
H Drain cock

FIG. 5—Diagram of Automatic Rate-of-dyeing Apparatus

dyeliquor down the tube, up the other arm containing the material to be dyed, and then through the cross-arm of the apparatus. A beam of light passes through this cross-arm to a color filter and then on to a photoelectric cell. As dyeing proceeds the color of the solution decreases and more light is passed to the photocell, thus increasing the current produced. The beam of light is interrupted by a chopping disc, so that the photocell output is alternating in character and can be amplified by an ordinary A.C. amplifier. After rectification, the output is fed to a galvanometer. Thus, as the dyebath decreases in strength on dyeing, an increase in current from the photocell is recorded on the galvanometer. The apparatus is calibrated for each dye by filling it with solutions of known strength and plotting galvanometer readings against dye concentration. The actual dyeing operation is carried out by dropping the chopped yarn (contained in a glass tube fitting closely inside the U-tube arm and having a perforated porcelain bottom through which dyeliquor can flow) into the dyebath and recording the galvanometer indications at 2-min. intervals.

With regard to the accuracy of the results obtained with this apparatus, it should be pointed out that the rate of stirring was made constant by using an induction motor to drive the circulating propeller at a constant speed, whilst the packing of the cotton in the other arm of the U-tube was fairly reproducible because of the use of a fixed weight of yarn of a definite length enclosed in a glass tube of known diameter.

In practice it was found that several of the curves repeated at widely spaced intervals of time did not differ from one another by more than 2 per cent or 3 per cent actual at any point. The accuracy of these measurements thus seemed to be adequate for practical purposes. A detailed analysis of 6 repeat curves of Chlorazol Dark Green PL 125 is given in Table III and indicates that when the curves are measured in immediate succession a

(Continued on Page 419)

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STUDENT CHAPTERS

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1945 Bibliography of Color

DR. I. H. GODLOVE

Chairman, Committee on Color

This Bibliography of Color constitutes a portion of the report of the Committee on Color which will appear in the 1946 Year Book. Separate publication of this part of the report was necessitated by the voluminous literature on this subject and the need for curtailment of space in the Year Book. To conserve space the compiler has departed from the previous custom of presenting a running account followed by the bibliographical list. The present method combines the two parts.

Abbreviations which appear frequently are indicated as follows: ADR—American Dyestuff Reporter; JOSA—Journal of the Optical Society of America; JSDC—Journal of the Society of Dyers and Colorists.

1. Light Sources, Light Filters and Lighting.

W. E. Forsythe and E. Q. Adams, JOSA *35*, 108 (correction, p. 306), during the year publish an outstanding summary of the radiating characteristics of tungsten and tungsten lamps. Other papers in the same field are: E. F. Caldin, Proc. Phys. Soc. *57*, 440, giving the relation between brightness and temperature of a total radiator (2000-3120°K.); H. G. W. Harding, Proc. Phys. Soc. *57*, 222, illuminants for colorimetry and the colors of total radiators; E. Appleton, Nature *156*, 534, departure of long-wave solar radiation from black-body intensity; F. Benford, JOSA *35*, 149, the projection of light; M. Reiss, JOSA *35*, 283, the fourth-power-of-cosine law of illumination; M. K. Kidd, Brit. J. Photog *92*, 98 (March 23), daylight as a dark-room illuminant; and Illuminating Engineering Society Committee on Art Gallery Lighting, Illum. Engin. *40*, 11, art-gallery lighting.

L. A. Jones and R. N. Wolfe, JOSA *35*, 559, publish a method for the measurement of the energy distribution in optical images; M. T. Jones, R. J. Zavesky and W. W. Lozier, J. Soc. Mot. Pict. Engin. *45*, 10, a method for the measurement of the brightness of carbon arcs; and H. F. Launer, ADR *34*, P 264, discusses the standard fading lamp of the National Bureau of Standards and means of calibrating other fading lamps in terms of it. For a method of calibrating lamps, see also C. A. Seibert in Section 4. In JOSA *35*, 615, is a note by D. L. MacAdam on the maximum luminous efficiency of radiant energy. In Amer. Photog. *39*, No. 2, 34, is a brief article by M. Rettinger on the measurement of light intensities; this reference is itemized in Section 5, where are also discussed a photographic daylight recorder (Farrow & Pelton) and graphical correlation of transmittances and thicknesses of filters (McLeod); while in Section 7 is an article on lighting for studio portrait color photography (Maingot).

H. Hurwitz, Jr., JOSA *35*, 525, discusses the statistical properties of unpolarized light; U. S. Pat. 2,383,186 (Glasser) protects binoculars with polarized light filters, while Brit. Pat. 570,837 to International Polaroid Corp. protects a sheet of light-polarizing plastic material. G. B. Harrison, Photog. J. *85B*, 57 (May-June), discusses the scattering of light in the atmosphere. Ultraviolet light filters are patented in U. S. Pats. 2,369,084 (F. E. Stockelbach, assignor to Fries Bros., Inc.), 2,370,244 to D. H. Jacobs and 2,386,855 to W. Horback (both assigned to Celanese Corp. of Amer.). The ultra-violet transmission of a score of organic solvents is given by M. E. Maclean et al in the March, 1945 issue of J. Research Natl. Bur. Stand (RP 1643). H. P. Gage in JOSA *35*, 276, publishes an interesting paper on the thickness control of the sharp cut-off type of filter glasses; this paper is reviewed in ISCC News Letter No. 62 (Nov.), p. 11. Abstract of a 1943 article by F. Blottiau, on ideal colorimetric filters and the possibility of realizing them to test actual filters, was obtained in Chem. Abstr. *39*, 5178 (1945).

2. Vision and Color Perception.

For a general article on color containing sections on vision, see White and Vickerstaff in Section 6; and for an elementary review of color theories, color vision and color systems, see Section 3 under Varden. G. Wald, Science *101*, 653, discusses human vision and the spectrum in a general way. P. Moon and D. E. Spencer, JOSA 35, 43, outline a modified (eclectic) photochemical theory of color vision; while G. A. Fry, JOSA *35*, 114, develops a photoreceptor mechanism for the "modulation" theory of color vision. A critical note on this theory was published by D. L. MacAdam, JOSA *35*, 616; a reply by Fry follows on page 617. Moon and Spencer discussed also within the year the visual effect of non-uniform surrounding fields, JOSA *35*, 233. In Nature *155*, 750, is reported a lecture by R. Granit on the electrophysiological analysis of the "fundamental problem of colour reception"; and on page 711 of the same volume is an article by this same author on the isolation of mammalian color receptors with micro-electrodes. It is claimed that spectral sensitivity curves of different animals are of two types: (1) "dominators," with a maximum at about 560 mu; and (2) narrow bands or "modulators" in the regions 580-600 mu (red), 520-40 (green) and 450-70 mu (blue), varying from animal to animal. The former are supposed responsible for brightness perception, the latter for chromaticity. The present paper gives the work on de-cerebrated cats. A paper by Wundheiler on the "MacAdam ellipse" sensitivity data is listed in Section 4. In ISCC News Letter No. 61 (Sept. 1945), 8-10, the editors discuss S. E. Sheppard's theory of overlapping trichromatic excitation curves. In a letter Sheppard revives a suggestion made by Professor S. Hecht and kept alive by a 1944 paper of J. Mandelbaum and E. U. Mintz.

Color vision in the center of the retina, the depression known as the *fovea centralis*, has been discussed by three writers in Nature, volume *145* (L. C. Thomson, p. 177; M. H. Pirenne, p. 177-8; and H. Hartridge, p. 391). In volume *146*, page 119, is an article by E. N. Willmer and W. D. Wright on the color sensitivity of this region, which is reviewed in ISCC News Letter No. 62 ((Nov.), 10. According to them, the fovea is dichromatic, cannot distinguish blue-green and has various characteristics of the tritanopic form of color blindness. In Nature *155* are also an article by N. I. Pinegin, p. 20, absolute scotopic sensitivity of the eye in the ultra-violet (and in the visible spectrum); and one by E. E. Schneider, p. 176, titled color phenomena in ultra-violet vision. In the

same volume, p. 178, F. W. Edridge-Green discusses the persistence of vision. S. Hecht and Yun Hsia, JOSA *35*, 261, discuss the moot question of dark adaptation following light adaptation to red and to white lights, a question important during war times. G. Wald, JOSA *35*, 187, in the first of a series on the spectral sensitivity of the human eye, describes a special adaptometer.

In Section 5 is listed a paper by Shaxby on a form of the anomaloscope for testing color-vision anomaly; and in the same section is listed a portion of the OSA Colorimetry report by L. A. Jones et al. R. W. Pickford, Nature *156*, 506, discusses "darkened violet in color vision," and the same worker in vol. *155*, 336, mentions a case of color blindness in one eye following an accident, and its bearing on seven color-vision theories. F. L. Dimmick, Text. Colorist & Converter, November issue, p. 114, describes the ISCC test for color aptitude. The Institute of Paper Chemistry on Feb. 15 published Report No. 34, part II, "progress report on the study of color blindness by means of a monochromatic colorimeter." In J. Franklin Inst. *239*, 54, is an anonymous note on colorblindness tests. LeGrand H. Hardy, S. Rand and M. C. Rittler, in JOSA *35*, 268 and 350, publish two papers on the Ishihara test for the analysis of color blindness; on p. 481 is a paper by them on the similar Rabkin test. E. L. Green and L. L. Sloan, JOSA *35*, 723, publish two criteria for the selection of color-vsision test-plates; and the last-named author, p. 761, has a paper on an improved screening test for red-green color deficiency composed of available "pseudo-isochromatic plates." D. B. Judd, JOSA *35*, 199, has computed standard response functions for two types of color-blindness, protanopic and deuteranopic vision. In ISCC News Letter No. 57 (Jan.), 8-9, he gives a classification of types of color-blindness along "classical" lines, defining eleven terms and comparing them with terms proposed by Lieut. Farnsworth.

Finally, in this section may be mentioned two books on eyesight. L. H. Schwartz' "Your Eyes Have Told Me," E. P. Dutton, pp. 208, is reviewed in Science *103*, 120, by LeG. H. Hardy. The Metropolitan Life Insurance Co., Industrial Health Series Bull. No. 4: "Methods of Testing and Protecting Eyesight in Industry," 70 pp., is reviewed in ISCC News Letter No. 60 (July), 10-11.

3. Color Terminology, Description and Specification.

L. E. Varden, Amer. Annual Photog. *59*, 7, under the title "aspects of color," has published an elementary review of color theories, color vision and color systems, with many references. A review by K. F. Stultz on the measurement and specification of color is listed in Section 5. G. Welp, Amer. Ink Maker *23*, No. 1, 27, 29, 31, 47, under the title "background on color," refers to the increasing use of color and the Munsell system of color identification and points out the need for a common language. D. L. MacAdam, JOSA *35*, 293, tells how he prepared the printed spectrum and other color work in the earlier feature article which had appeared in the magazine *Life*. W. Schweisheimer, Text. Colorist & Converter, November issue, discusses color names under the title "look what we missed in color names." A brief review of this article may be found in ISCC News Letter No. 57 (Jan.), 7-8. There too, News Letter No. 58 (March), 3-5, may be found a discussion of color terminology. Dyestuff nomenclature is discussed by C. L. Bird in J. Soc. Dyers Col. *61*, 321, who gives extensive tables of British, French and Swiss commercial type names, with dyeing class and use, chemical class and maker, all arranged alphabetically by maker's type names.

The work of O. C. Compton, D. Boynton, E. S. Philips and W. C. Granville, Cornell Univ. Agr. Expt. Stat. Bull. No. 824, "Color Standards for McIntosh Apple Leaves; preliminary studies of leaf color in relation to nitrogen fertilizer," is reviewed in Sci. News Letter, Feb. 10, p. 88 and in ISCC News Letter No. 61 (Sept.), 4-5; this work on the spectrophotometry of apples and the new standards which help "to get redder apples" are also the subject of an anonymous article in Science Suppl. *101*, 10 (Feb. 9). An anonymous article in J. Franklin Inst. *240*, 123, discusses color standards for aviation lights (work at the National Bureau of Standards). R. B. Willcock, Brit. J. Photog. *92*, 218, discusses artificial color standards for pH indicators; while J. M. Vandenbelt, J. Forsyth and A. Garrett, Indus. Engin. Chem., Anal. Ed. *17*, 235, publish an article on the extinction coefficients of spectrophotometric standards. In the field of color standards also is found a new system of color-matching fluids, an advance over those originally introduced by Arny; this work is given by K. L. Kelly in J. Amer. Pharm. Assoc., Sci. Ed. *34*, 59.

The colorimetric specification of the Wratten light filters, widely used by color workers, has been given by D. L. MacAdam, JOSA *35*, 670; and the very extensive work at the National Bureau of Standards on the specification of railroad signal colors and glasses has been further treated, JOSA *35*, 772, by K. S. Gibson, G. W. Haupt and H. J. Keegan. The work of R. Granit on the color receptors was mentioned in Section 2.

4. Evaluation of Color Changes (as in Fastness Tests), Color Tolerances, Matching and Discrimination.

In connection with discrimination data, L. Silberstein and D. L. MacAdam, JOSA *35*, 32, have given a theoretical treatment of the distribution of color matchings around a color center; and A. W. Wundheiler, JOSA *35*, 767, has treated the MacAdam discrimination ellipses, while R. H. Sinden, JOSA *35*, 737, has also published a note on MacAdam's determination of chromaticity sensibilities. For the mathematical treatment of sensibility and discrimination data it is often convenient to have analytical expressions rather than tables of data or graphical curves; and in this connection two papers by P. Moon and D. E. Spencer, JOSA *35*, 399 and 597, are of considerable interest. The paper of these mathematicians on the visual effect of non-uniform surrounds was mentioned in Section 2. Other mathematical papers include one on the geometrical solution of some color-mixture problems, by M. M. Gourevich, JOSA *35*, 196; and a summary of the complete optics of the mathematician Euclid, by H. E. Burton, JOSA *35*, 357. As the first paper of a series on the spectral sensitivity of the human eye, G. Wald, JOSA *35*, 187, describes a spectral adaptometer. MacAdam's description of the *Life* article presenting, in color, certain discrimination data, was mentioned in Section 3. Certain new data, transmitted by C. V. Dominquez, determining a "value scale" which is in excellent agreement with the Munsell scale of values or lightnesses, are given by the editors in ISCC News Letter No. *60* (July), page 2.

A general review on color, by White and Vickerstaff, is listed in Section 6. An article of a different type but of a general nature too is G. Welp's "tomorrow's world requires knowledge of color," Text. Colorist & Converter *67*, 718, 736. Lieut. Andrews and Biskup, Off. Digest Fed. Paint Var, Prod. Clubs, June issue, p. 281, outline a simplified method of color specification and control which utilizes the Hunter reflectometer. The work of Compton et al and of Willcock on color standards was mentioned in Section 3. Sheppard's suggestion of overlapping trichromatic excitation surves was mentioned in Section 2.

An interesting paper was one by T. Vickerstaff, Proc. Phys. Soc. *57*, 15, on the brightness of present-day dyes. This subject was treated by I. H. Godlove in a paper before the Optical Society of America in 1943; he reviewed Vickerstaff's work in ISCC News Letter No. 59 (May), 8-9. It is brought out that in securing brightness in dyes, synthetic organic chemists have gone nearly as far as they can go in

the case of the yellows; but in the case of the greens and blue-greens and perhaps the purples, they have gone only a small part of the way. Vickerstaff's results have been put into a form more familiar to American readers by Miss D. Nickerson in the Nov. issue of Rayon Textile Monthly, under the title "are new colors limitless"; she compares the theoretical pigment limits and the Munsell limits of saturation (chroma) at various points in the color solid.

Very many papers and patents cover the field of fastness testing and the color changes in fastness testing. Papers by D. P. Knowland and W. A. Holst, ADR *34*, P 166. P 426, and by W. A. Holst, ADR *34*, P 500, give respectively the report of the ATCC Commitee on Transference of Color and the committee's "new tool for evaluating color transference." The "new tool" is the AATCC-Munsell chart having 24 color chips of the hues red, yellow, green, blue, purple and gray, in four depths each, for evaluating the size of the color changes due to transference. Papers by H. F. Lewis, E. A. Reineck and D. Fronmuller, Paper Trade J. *121*, No. 8, 44, and by P. Nolan, J. A. Van den Akker & W. A. Wink, Paper Trade J. *121*, No. 11, 33, discuss work on the "fading" of groundwood by light. An interesting paper by C. A. Seibert, ADR *34*, P 272, proposes a new method for the calibration of carbon-arc lamps used for testing and grading lightfastness. Mr. Seibert, the outstanding worker in this field attempts to use a relation between dye concentration on the fiber and measured reflectance based upon considerations current in the paper industry, employing tables prepared by E. R. Laughlin for the "K/S values" deriving from the work of Kubelka and Munk. Comments on the limitations of the method are given (*34*, 280) by Dr. Laughlin.

In an important paper on the fading and "tendering" activity of vat dyes, Y. M. Waly, J. M. Preston, F. Scholefield & H. A. Turner, J. Soc. Dyers Col. *61*, 245, find an excellent correlation of the shift of redox potential in the light, as compared with the dark, with the tendering activity. Capt. S. Backer & R. Harwood, ADR *34*, P 265, have made an important study of some variables in the weathering tests of textile fabrics. H. A. Ehrman, ADR *34*, P 255, discusses the importance of standard test methods, ratings and terminology for color fastness; color-fastness tests are also discussed by A. R. Docking, Text. J. Australia *20*, 241. The article on the new NBS standard fading lamp by Launer was mentioned in Section 1. H. A. Lips, Paper Trade J. *120*, No. 11, TAPPI Sect. 108, discusses the establishment of standard testing methods for light fastness in the paper industry; and the Philadelphia Paint & Var. Prod. Club, in Amer. Paint J. *30*, No. 6A (Convention-at-Home Daily), p. 19, discusses proposed standards for determining the degree of color change of paints and enamels (a study based on the use of the Munsell system).

N. D. Lobar, Text. World *95*, No. 10, 133, 190, 192, 194, 197, maintains that dyeing techniques can minimize gas-fading of dyeings on cellulose acetate. Recent patents on the prevention of this type of fading are: U. S. Pats. 2,369,122 and 2,371,221 and Brit. Pat. 569,557. A patent on the prevention of discoloration is U. S. Pat. 2,370,552; while other patents on improved color fastness are U. S. Pat. 2,373,191 and Brit. Pats. 571,056; 571,677, and 571,971.

5. Instruments and Color Measurement.

Chapter VIII of the Optical Society of America Colorimetry Committee report (L. A. Jones, chairman) appeared during 1945 in JOSA *35*, 1. W. D. Wright's 1944 book, "The Measurement of Colour," was reviewed during 1945 by F. I. G. Rawlins, Nature *155*, 287; by C. B. Stevens in JSDC, *61*, 128; by the editors of ISCC News Letter No. 58 (March), 9-10; and by I. H. Godlove, Chem. Engin. News *23*, 946. E. B. Brown's book, "Optical Instruments," was published by the Chemical Publishing Co.; while the fourth ed. of A. Cox's "Optics; the Technique of Definition," was published by the Focal Press, London and New York. M. G. Mellon's "Colorimetry for Chemists," a 133-page booklet, was reviewed in ISCC News Letter No. 64 (March 1946), p. 6. The last-named author also has an article on "light-absorption spectrometry" in Indus. Engin. Chem. *17*, 81. J. Yudkin, Nature *155*, 50, briefly discusses absorption colorimetry as an anlytical technique. W. C. Granville's 1944 article on spectrophotometry in evaluating colorants was reviewed in ISCC News Letter No. 57 (Jan. 1945), 5. He also has an article, specification of color, in Interchemical Rev. *4*, No. 1, 3 (Spring 1945). K. F. Stultz, Natl. Paint Var. Lacq. Assoc., Sci. Sect. Circ. No. *708*, 435, discusses the measurement and specification of color; while White and Vickerstaff's general review on color has been mentioned. G. Welp, Amer. Ink Maker *23*, 27, 29, 31, 47, in an article titled "background on color," touches lightly on a broad field (trade names, Munsell system, spectrophotometry, specifications, contrast effects of background, and rules of color composition).

A. C. Hardy, JOSA *35*, 289, discusses illuminating and viewing conditions for spectrophotometry and colorimetry. In a series of papers, G. L. Buc & E. I. Stearns, JOSA *35*, 458, 465, 521 and 742, discuss various uses of retardation plates in spectrophotometry. H. H. Taylor & F. T. Simon, ADR *34*, 319, discuss the use of polyethylene-oxide condensates as an aid in the spectrophotometry of dyestuffs; this interesting work was reviewed in ISCC News Letters No. *61* (Sept.), 10 and No. *62* (Nov.), 8. R. P. Teele, J. Research Nat. Bur. Stand. *34*, 325, described a photometer for luminescent materials; and W. H. Byler & C. C. Carroll, JOSA *35*, 258, published a method for determining the chromaticity of fluorescent materials. Serious errors from this source are known to exist in measurements made with the Hardy-General Electric spectrophotometer, for example. J. S. Friedman, columnist for American Photography, has articles on densitometry in that journal, January issue, p. 42, and March issue, p. 40. An article on the sensitometry of the Agfacolor process, by W. Schneider & H. Berger, appearing in Z. wiss. Photog in 1943, was abstracted in the Kodak Monthly Abstr. Bull *31*, 329 in Nov. 1945. M. H. Sweet, J. Soc. Mot. Pict. Engin. *44*, 419, discusses the sensitometry of modern reversible color film; and describes a sensitometer in JOSA *35*, 379. M. Rettinger, Amer. Photog. *39*, No. 2, 34, discusses the measurement of light intensities; and F. Mader, Helv. Phys. Acta *18*, 125, describes a universal apparatus for spctral and integral light and color measurement. The article of Jones et al on the measurement of brightness of arcs was mentioned in Section 1; and that of Vandenbelt et al on extinction coefficients in Section 3.

Spectrophotometers, photometers and colorimeters for special applications are described by: D. B. McRae, JOSA *35*, 510; N. B. Foster & L. W. Foskett, JOSA *35*, 601; J. M. Sowerby, J. Sci. Instr. *21*, 42; O. W. Pineo, U. S. Pat. 2,383,075; H. L. Andrews & B. L. Horecker, Rev. Sci. Instr. *16*, 148; and General Electric Co., Special Products Div., Instruments *18*, 46. A constant-illumination densitometer is described by E. W. Geniesse, Amer. Photog. *39*, No. 1, 14; and a direct-reading color densitometer by M. H. Sweet, Electronics, March 1945, 102.

Spectrophotometry has been resorted to in the study of cerium complex ions (R. L. Moore & R. C. Anderson, J. Amer. Chem. Soc. *67*, 167), the determination of nickel (A. M. Mitchell & M. G. Mellon, Indus. Engin. Chem., Anal. Ed. *17*, 380) and of formaldehyde (C. E. Bricker & H. R. Johnson, ibid, *17*, 400), analysis of coal-tar colors (G. R. Clark & S. H. Newburger, J. Assoc. Off. Agr. Chem. *27*, 576), and with methyl violet used as a

"tracer," the determination of ink coverage and its relation to printability (see Section 6). E. Sharratt et al have used the Spekker Absorptiometer for estimating the specific surface of powders.

Wilcock's paper on pH color standards was mentioned in Section 3. L. Koch, Amer. Ink Maker *24*, No. 1, 27, 29, 31, has a paper on the systematic identification of organic ink colors and their bases. D. A. Lyon, JOSA *35*, 157, discusses optical applications of metallic and nonmetallic films; and R. L. Mooney discusses reflection-reducing optical coatings, JOSA *35*, 574. H. P. Gage's paper on filters was mentioned in Section 1; the graphical correlation of transmittances and thicknesses in optical filters is discussed by J. H. McLeod, JOSA *35*, 185, and by H. E. Powell, JOSA *35*, 428. Burton's paper on the optics of Euclid was listed in Section 4; the theory of the concave grating is discussed by H. G. Beutler in JOSA *35*, 311; the Fresnel reflection of diffusely incident light by A. Gershun in JOSA *35*, 162; and the optics of water by E. O. Hurlbut, JOSA *35*, 698.

B. Farrow & M. O. Pelton, J. Sci. Instr. *22*, 210, describe a photographic daylight recorder; W. E. Curtis & T. A. Littlefield, ibid, 215, describe a stereopiscope; J. H. Shaxby, in the same issue (January) of J. Sci. Instr. describes a simple form of Nagel anomaloscope for testing anomalous color vision; and W. A. Shurcliff, in U. S. Pat. 2,383,346, protects a spectrophotometer attachment for eliminating specular reflection. Wald's adaptometer was mentioned in Section 4; Kelly's color-matching fluids in Section 3; and Gourevich's paper on the geometry of color-mixing in Section 4.

6. Color Psychology, Color Science Broadly (including "Color" and Chemical Structure), and Miscellaneous.

In this section may be listed several books published or reviewed during 1945. Faber Birren's outstanding "Selling With Color" was reviewed by D. B. Judd in ISCC News Letter No. 60 (July), 2-4. G. E. K. Branch & M. Calvin's "The Theory of Organic Chemistry" contains an excellent section, pp. 155-82, on "color" in relation to chemical structure. The same is true of G. W. Wheland's "The Theory of Resonance," chapter 6 of which treats of this subject; it was reviewed by I. H. Godlove in ISCC News Letter No. 57 (Jan.), 9-12. B. K. Johnson's "Practical Optics" was published during 1945; and there was a brief review of W. F. Leggett's "Ancient and Medieval Dyes" in J. Chem. Educ. *22*, 207. A general article on color, a review, is the excellent one by G. S. J. White & T. Vickerstaff, JSDC *61*, 213.

Reviews of the relation of "color" (absorption spectra) to chemical structure (along with a review of Wheland's book) and of the effect of solvents on absorption spectra (work of S. E. Sheppard et al) by I. H. Godlove may be found in ISCC News Letter No. 57 (Jan.), pp. 9-12 and 12-14, respectively. R. N. Jones, J. Amer. Chem. Soc. *67*, 2127, in a general survey sets out the factors influencing the ultraviolet absorption spectra of polynuclear aromatic compounds, indicating relations which may be carried over into the visible spectrum. G. N. Lewis and co-workers continue their work in this field, for example with a paper giving the empirical rules for the absorption spectra of dyes (J. Amer. Chem. Soc. *67*, 770). L. G. S. Brooker and his co-workers, in the same journal, also continue their series on "color and consitution," papers VII and VIII, for example, being in vol. *67*, pp. 1875 and 1889. E. A. Braude, Nature *155*, 753, points out that simple geometrical considerations, classical theory and quantum theory and the experimental results all yield the fifth power of ten as the order of magnitude of the maximum values of the molar extinction coefficient. H. H. Hodgson & D. E. Hathway, in two papers, Trans. Faraday Soc. *41*, 115 and JSDC *61*, 283, discuss the absorption spectra of nitronaphthylamines. Hodgson and his coworkers, who have made many applications of modern electronic and resonance theories, find agreement of the predictions of these theories in this field with certain empirical rules of Vesely and Jakes (1923). L. Michaelis & S. Granick, J. Amer. Chem. Soc. *67*, 1212, discuss the "metachromasy" or variability of color of adsorbed (basic) dyes and its relation to Beer's Law. Related to the adsorption of dyes is a paper by S. E. Sheppard & A. L. Geddes, J. Chem. Physics *13*, 63, on the "amphipathic" character of proteins and certain lyophylic colloids as indicated by the absorption spectra of dyes. G. E. K. Branch, B. M. Tolbert et al discuss the absorption spectra of two diamino triphenylmethane dyes derived from carbazole and certain dyes related to malachite green and viridine green (J. Amer. Chem. Soc. *67*, 1693, 454 and 887). I. K. Kiprianov et al, J. Genl. Chem. USSR *15*, 200 and 207, discuss the thiocarbocyanines with electropositive and with electronegative substituents. P. Karrer, Vierteljahrsschr. naturforsch. Ges. Zurich *90*, 1, gave a lecture on the known natural carotenoids and their absorption spectra. E. V. Shpol'skii & E. V. Grishkun, J. Phys. Chem. USSR *19*, 107, discuss photochemical sensitization by dyes and the quenching of fluorescence in solutions. B. Ghosh, J. Indian Chem. Soc. *22*, 21, discusses the effect of temperature and magnetic and electrical fields on the absorption spectra of chromium and cobalt chlorides; and a note by A. G. Gaydon, Nature *155*, 452 discusses the absorption spectra of the mercury halides. R. F. Milligan et al, Indus. Engin. Chem., Anal. Ed. *17*, 569, discusses the identification of the sulfonated azo-2-naphthol dyes. Vickerstaff's work on the brightness of present-day dyes was reviewed in Section 4. G. Broun, Text. Bull. *68*, No. 8, has a paper on dyes and the study of dyeing.

H. A. Standing, Trans. Faraday Soc. *41*, 411, has prepared an excellent review of the dyeing of cellulose with direct dyes; while the presidnt of the AATCC, W. D. Appel, ADR *34*, P 21, has made a fine survey of the synthetic fibers, and C. W. Bendigo, Text. World *95*, No. 9, 117, has presented the properties of the synthetic fibers in tabular form.

Turning to the field of the psychology of color, we find discussion of some applications in ISCC News Letter No. *60* (July), 10, in connection with the work of G. D. Gaw & L. Cheskin. T. Vickersta & C. S. Woolvin, J. Oil Col. Chem. Assoc. *27*, 209, report an investigation of the legibility and esthetic value of colored printing inks on colored paper. Welp's paper, "background on color," was described in Section 5; another paper of his is titled, "tomorrow's world requires knowledge of color," Text. Colorist & Converter *67*, 718. W. Schweisheimer, in Text. Colorist & Converter, has discussed the effects of fabric color and weight on general health (p. 579) and psychological associations in an article entitled "color is a form of superstition" (p. 659). L. J. Heffernan, Movie Makers *20*, 53, 64, 92, 108, has written on "painting with lights," the use of "Hollywood lighting" and the moods created by four types of lighting. R. L. Ives, who has previously discussed illusions, has a paper on sunset shadow bands, JOSA *35*, 736, while L. A. Jones & G. C. Higgins, JOSA *35*, 435, discuss the relation between the granularity and graininess of developed photographic materials with the thoroughness characteristic of Dr. Jones. In a patent on a psychological effect, the improvement of the whiteness of materials, P. W. Tainsch, Brit. Pat. 566,810, protects such improvement by means of a blue-fluorescing substance. F. Birren has a paper on color in the (manufacturing) plant, Factory Management & Maintenance, Feb. 1945.

Spectrophotometry of methyl violet used as a "tracer" is employed by R. Buchdahl & M. F. Polglase, Paper Trade J. No. 3, 41, to determine ink coverage and its relation to printability. Under the

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title "color harmony in the molding shops," J. A. Meacham, Modern Plastics *22*, No. 10, 105 (one page in full color), discusses systems of painting. I. H. Godlove has continued his reviews on color harmony, particularly in reviewing the work of P. Moon & D. E. Spencer and of A. Pope (ISCC News Letters No. *58*, March, 11-14; No. *60*, July, 9-10); and with the other editors has reviewed the work in closely related fields by M. C. Bradley, ISCC News Letter No. *61* (Sept.), 5-7. In the March and July issues, Godlove also continues his "Outline History of Color." In the ISCC News Letter No. *59* (May), 9-10, certain ideas of J. Scott Williams, artist, are reviewed under the title "color and the professional artist."

Miscellaneous articles of 1945 difficult to classify are the following: P. Moon & D. E. Spencer, JOSA *35*, 233, the visual effect of non-uniform surrounds; B. H. Zimm, R. S. Stein & P. Doty, Polymer Bull. *1*, 90, a classical theory of light scattering from solutions—a review; C. V. Raman, Nature *155*, 396, scattering of light in crystals; F. Palmer, Amer. J. Physics *13*, 203, unusual rainbows (note); W. J. Humphreys, Science *102*, 130, why the rainbow and the corona never are seen in the same cloud; V. Keppler, Camera (Baltimore) *67*, 20, 100, animal models in color; P. Kirkpatrick, Amer. J. Physics *13*, 267, problem in psychophysics; H. H. Kretschmer, Amer. J. Physics *13*, 111, color spectrograms for demonstration purposes; M. A. Lesser, Amer. Ink Maker *23*, No. 11, 27, invisible or sympathetic inks; C. W. Horton, Geophysics *10*, 186, analysis of oblique reflection data; A. Gershun, JOSA *35*, 162, Fresnel reflection of diffusely incident light; and W. H. George, Nature *155*, 763, Russian physics journals. Moon & Spencer's theory of vision was mentioned in Section 2; Hecht & Yun Hsia's paper on adaptation in red and white lights was listed in the same section; a summary of the optics of Euclid was mentioned in Section 4; and other cross-references to this section have also been given.

7. Applications of Color Science.

Among books, Cox's "Optics" was mentioned in Section 5; and during the year a review by R. H. Opermann of J. S. Friedman's "History of Color Photography" appeared in J. Franklin Inst. *239*, 70. A very large number of papers dealing with applications in color photography and in dyeing appeared during 1945.

Turning to dyeing first, we have a review of the mechanism of direct-cotton dyeing by R. E. Rose, Text. Research *15*, 383; H. A. Standing's review was mentioned in Section 6; there is also a paper on the absorption of chrysophenine by cellulose, by H. F. Willis et al, Trans. Faraday Soc. *41*, 506. O. W. Clark, ADR *34*, 546, has a review of fundamental principles of vat dying; Capt. R. S. Stribling, ADR *34*, P 99, discusses recent developments in the application of vat dyestuffs; P. W. Benn, Canadian Text. J. *62*, 43. discusses the continuous leuco-vat dyeing of cotton piece-goods; and P. L. Meunier, ADR *34*, P 206, describes the "pad-steam" continuous dyeing process. The paper of Waly et al on the tendering activity of vat dyes was mentioned in Section 4. W. N. Jones, Jr., Chem. Rev. *36*, 291, reviews the sulfur dyes. J. H. MacGregor & C. Pugh, JSDC *61*, 122, discuss the dyeing of nylon with direct-cotton dyes in the presence of cationic soaps; and an excellent paper on the mechanism of the dyeing of nylon with acid dyes is by R. H. Peters, JSDC *61*, 95. In the same journal, p. 193, and in ADR *34*, 435, 448, is a study of the absorption of acid dyes by nylon, wool, silk and casein fiber. Other interesting papers on wool dyeing include: W. Von Bergen, T. Crowley & W. Brommelsiek, ADR *34*, P 53; F. Townend, JSDC *61*, 144; and H. E. Millson, ADR *34*, P 284; the first covers continuous indigo dyeing and the second two-color dyeing. Turning to the other synthetic fibers, we have general papers by H. G. Scull & H. DeW. Smith, Rayon Text. Monthly *26*, 99, 1891 297; A. W. Etchells, ADR *34*, P 29; and P. J. Choquette ADR *34*, P 211. The paper of Lobar on minimizing gas-fading was mentioned in Section 4. The dyeing of mixed fibers is treated by L. S. Thompson, Cotton (Atlanta) *110*, No. 2, 95; causes of uneven dyeing by T. C. Hutchins, ADR *34*, 344; and a survey of Germany's wartime dyeing and printing by F. S. Richardson, Text. Bull. *69*, No. 6, 42, 44, 66. C. R. M. Oehlcke, JSDC *61*, 306, discusses the coloring of plastics. Among dyeing patents worth mentioning, perhaps the first to be mentioned is that to W. M. Wentz on the "Multilap" dyeing machine, U. S. Pat. 2,369,696. For dyeing nylon: U. S. Pats. 2,371,536 and 2,374,106; Brit. Pats. 568,092 and 570,602; and for printing nylon, U. S. Pat. 2,368,940. For dyeing cellulose acetate and similar materials: U. S. Pats. 2,366,241; 2,368,723; 2,375,839; and 2,384,001. For vat dyeing: U. S. Pat. 2,371,145; and Brit. Pats. 571,274 and 571,325. For dyeing iridescent polystyrene plastics: U. S. Pat. 2,383,765 to R. R. Bradshaw; and for production of two-toned fabrics, Brit. Pat. 570,880 to A. Mellor & R. J. Mann.

Turning to color photography, one finds a number of papers on recent Ansco processes: J. E. Bates, Amer. Photog. *39*, July 8, processing Ansco Color Reversible film; S. L. Judkins, Movie Makers *21*, 57, 72, Ansco Color movie film; R. M. Haff, Natl. Lithographer *52*, 20, 24, 64, application of Ansco Color paper to map making and reproduction; and an anonymous article in Brit. J. Photog. *92*, 242 Ansco colour (Ansco Color Reversible film, Ansco Color Reversible Printon, etc.). There are also M. H. Sweet's article, J. Soc. Mot. Pict. Engin. *44*, 419, on the densitometry of modern reversible color film; E. Briner et al, Helv. Acta *28*, 1612 (In French), on color photography (with Agfa color film) of emission, absorption and especially Raman spectra; and W. Schneider & H. Berger's article, Z. wiss. Photog. *42*, 43 (1943), abstracted in Monthly Abstr. Bull. *31*, 329 (1945), on sensitometry of the Agfa color process. A very fine review of color-development in photography is by A. G. Tull, Photog. J. *85 B*, 13. Other miscellaneous papers on color in photography include: H. Mountain, Brit. J. Photog. *92*, 170; R. Maingot, Photog. J. *85 A*, 255, the lighting and blending of color (studio portrait color photography); T. H. James, J. Photog. Soc. Amer. *11*, 73; a current view of exposure and development (latent-image theory of Gurney-Mott and growth of image silver crystals in development); L. W. Sipley, Photo-Engraver's Bull. *34*, 9, No. 6, color as we see it—photograph it—print it (elementary description of processes and theory); J. M. Centa, J. Photog. Soc. Amer. *11*, 22, 77, color printing with Pan-Chroma relief film; F. W. Sharp, Photog. J. *85 A*, 254, three-colour carbon printing; W. V. Strate, Minicam Photog. *8*, 50, experiments in color (photography); M. C. Richards, Science *101*, 312, a light-box for taking photographs in black and white or color; J. S. Friedman, Amer. Photog. *39*, 44, 46, color photography (meaning of "gamma," opacity, etc.); L. A. Mannheim, Amat. Photographer *95*, 37, color pictorialism (in color photography); A. A. Bodine, J. Photog. Soc. Amer. *11*, 8, color—its future in salons; and G. L. Wakefield, Process Engraver's Monthly *52*, 22, color prints of the future. A patent on dyeing films is to R. C. Greenlees, Brit. Pat. 571,961; and other photographic process patents include: U. S. Pat. 2,393,756 and Brit. Pats. 566,520; 566,684; 566,771; 566,772; 567,224; 569,646; 571,078; and 571,174.

A number of 1945 papers of general interest deal with pigments, especially of the phthalocyanine type; four which include the latter type are: P. L. Gordon, Amer. Paint. J. *29*, No. 40, 62, 64, 66, 68, 72; N. H. Haddock, JSDC *61*, 68; A. H. Woodhead, Paint Manuf. *15*, 192; and J. H. Haworth, I. M. Heilbron, D. H.

(Concluded on Page P417)

Package Dyeing in Germany*

THOMAS R. SMITH

OQMG Consultant

I. Machinery:

Generally speaking, the machinery for dyeing packages, cheeses and beams in pressure machines has not advanced as far in Germany as in the United States, with one exception, where rayon cakes have been dyed in a new machine developed jointly by Dr. Diem at the I. G. Farben Rayon Plant in Rottweil and Obermaier and Company of Neustadt on the Hardt, near Mannheim. This new development of rayon cake dyeing is explained further in Part IV.

The chief reason for the advanced development in the so-called package or cheese dyeing machine in the United States is due to the general use of stainless steel as compared to the continued use of cast iron in Germany in the fabrication of the machinery. The plants of Obermaier and Company at Neustadt and B. Thies of Coesfeld in Westphalia were visited and from information obtained it was disclosed that both plants worked largely on war material all during the period of hostilities. Both of these plants are still intact and are now being operated in their respective occupied zones, by the British in the case of B. Thies and the French in the case of Obermaier and Company for the manufacture of essential maintenance items such as for transportation and agricultural implements. Obermaier, however, is now being permitted by the French Army to manufacture a few rayon cake dyeing machines of stainless steel construction.

The plants of Kemken in Munchen-Gladbach; Tuchfabrik Schmitz, also in Munchen-Gladbach; Geor. Burkhardt in Pfullingen; Aktienfarberei in Munchberg near Hof; were visited, all of which contained installations of machinery for the dyeing of either packages, cones, cheeses or beams and the construction was entirely of cast iron which had been manufactured quite some years ago; not modern in any sense as we now have in the United States. At only one plant, that of Kemken in Munchen-Gladback, machinery was in operation and in this case for the dyeing of sulfur black only. At the plant of Geor. Burkhardt preparations were being made for the dyeing of Zellwolle or spun rayon on beams in the Thies machine, but also the machinery was of a very old date, and this type of machine was in use in the United States as far back as 1926 or 1927.

* Presented at Victory Convention, Hotel Pennsylvania, New York, January 4, 1946.

II. Kupensaure or Vat Acid Procedure:

Methods of application used in Germany for package machines were found to be—from interrogation of personnel at the various plants—similar to those methods used in the United States with reference to various types of dyes, such as for instance: vat, direct, sulfur, diazo, etc., with the exception of a new method of vat-dye application, known as the "Kupensaure" or vat-acid procedure which was developed especially by the I. G. for the dyeing of vat colors on rayon, both spun and filament, but mostly for spun rayon or Zellwolle. The Germans also used water soluble leuco vats to a larger extent in package and beam dyeing than we have in the United States. This procedure will be explained in Part III.

The chief advantage of the Kupensaure or vat acid method is to produce more level dyeing throughout the package, cheese, beam or cake, whichever the case may be. It is claimed by the I. G. that this method will produce more uniform dyeings, but it should be stated that the application is very exacting and the method has not been widely used in Germany to this day. The type of machine best suited for the vat acid procedure is one with a device for continuous flow of caustic soda and hydrosulfite additions. The dyeing process will be more difficult to carry through with machines not equipped with such a device. Satisfactory results depend largely on the careful observation of dyeing conditions and on strictly following the directions for adding the chemicals as regards concentration and quantity.

Forerunner of the Vat Acid Procedure, which is principally designed to overcome difficulties in applying vat dyestuffs to spun rayon, is the Stock-Vat Process. The principle of the Stock-Vat process is based on the dilution of concentrated vats with the addition of caustic soda to the dye-bath. Here the sodium leuco compound present in the concentrated stock vat hydrolizes, more or less, into the free leuco compound, according to the properties and concentration of the dyestuff, and only the non-hydrolized part of the dyestuff (the sodium leuco compound) exhausts. By adding caustic soda and hydrosulfite slowly, a gradual and continuous exhaustion is accomplished. Generally the results obtained with the stock-vat method are good with regard to penetration and levelness; it fails however, in such cases where the dyestuffs hydrolize with difficulty. This is also the case with dyestuffs which are easily hydrolized as for instance the blue shades.

The so-called "Vat Acid Procedure" eliminates these inadequacies by converting the sodium leuco compound present. It is also possible to control the exhaustion by adding caustic soda and sodium hydrosulfite slowly. When preparing the dyebath and carrying out the dyeing process according to this "Vat Acid Procedure" the following details have to be observed.

(A) PREPARATION OF THE STOCK VAT

The vatting is carried out to the prescription for stock vats of highest and medium concentrations. Which formula is chosen depends on the volume of the stock vat which is easiest to handle. For large quantities of dyestuffs, the formulas for stock vats of highest concentrations should be applied, while for small quantities of dyestuffs those for stock vats of medium concentration should be used. 10 grams of Setamol WS per liter should also be added to the stock vats.

(B) PREPARATION OF THE DYEBATH

To prepare satisfactory diluted acid solutions it is absolutely necessary to use distributing agents in the dyebath. They particularly serve to maintain stability and fine dispersion of the vat acid. For this purpose Setamol WS with Peregal OK has proved most suitable; 1 g. per liter of each is added to the dyebath. Exceptions are Indanthrene Blue BC, GCD and

Indanthrene Brilliant Blue RCL, where the Peregal OK is to be replaced by the same quantity of Medialan A or Igepon T since Peregal OK forms precipitates which are difficult to dissolve.

The mentioned quantities of 1 g. Setamol WS, 1 g. Peregal OK and Medialan A or Igepon T respectively are not to be understepped, otherwise the dyebath may be precipitated. Generally, these quantities ar sufficient to keep the dyestuff present in the form of vat acid well dispersed even in the case of dyebaths below the proportion 1: 20 and consequently higher concentrations. Only when using Indanthrene Blue BC Powder fine and Indanthrene Blue RCL fine for dyeing higher concentrations than 3.5 and 7 . per liter are to be avoided.

For the vat acid procedure the following dyestuffs are not suitable:

1. Indanthrene Brilliant Pink BBL
   Indanthrene Blue GC, GCN
   Indanthrene Blue 3GT
   Indanthrene Turkey Blue GK
   Indanthrene Turkey Blue 3GK

as they cannot be vatted in concentrations, and

2. Indanthrene Blue 5G
   Indanthrene Green BB
   Indanthrene Green GT

as their vat acid solutions are precipitated.

The following dyestuffs can only be regarded suitable to a limited extent:

1. Indanthrene Yellow G

having a tendency to precipitate when being used as proper dyestuff for its own, but suitable in various combinations as f. i. with the Indanthrene Brilliant Green (Jade Green) and Indanthrene Olive Green brands with Indanthrene Olive T and Indanthrene Grey M and MG.

2. Indanthrene Brilliant Orange GR
   Indanthrene Scarlet GC
   Indanthrene Blue 3G, 3GN
   Indanthrene Brilliant Blue 3G

Of these dyestuffs the free vat acids can only be kept in solution without flocking out in concentrations of 1-2 g. per liter by increasing the quantity of Setamol WS to 2-10 g. per liter of dyebath.

The vat acid solutions prepared according to the above orders with the aid of distributing agents possess an excellent stability satisfactory for practical requirements.

The transfer of the sodium leuco compound into the free vat acid is externally recognizable by a pronounced change of color. An exception is Indanthrene Brown 3GT; with Indanthrene Brown FFR and R the change is not very pronounced.

(C) DYEING PROCESS

Regarding the carrying out of the dyeing process itself, it has already been emphasized in the beginning to take care especially that the caustic soda during the first half hour be added in small portions in order to regulate the speed of exhaustion by transferring slowly and gradually the vat acid into the substantive sodium leuco compound.

The quantity of caustic soda to be added corresponds to that of a normal dyeing process with even relationship of the liquor, so that in the end the effect of the quantity of caustic soda of a normal vat is obtained. Whenever the construction of the dyeing-apparatus makes it possible, it is advisable to add the caustic together with the hydrosulfite by means of a metered vessel in such a way that the concentration in the dyebath increases to 4 cc. per liter within the first half hour. Thereby the dyebath will be exhausted slowly. The remainder can now be added quickly since the zone of danger is only at the beginning of the dyeing process. If the apparatus does not permit the continuous addition of caustic this has to be added gradually. Generally, it has been found appropriate for medium and deep shades to start with 1/15 of the total quantity of caustic, adding further 2/15 after 10 minutes and 8/15 ten minutes later. With very light tones with goods to be penetrated with difficulty or with dyestuffs to be levelled with difficulties when a continuous flowing is impossible, in the first part of the dyeing procedure the caustic has to be added in small quantities of 1/15, 2/15, 4/15 or possibly even smaller up to a concentration of 4 cc. per liter. The remainder of the caustic can usually be added in one addition after the concentration has reached 4 cc. per liter.

	2/20	1/20	1/20	1/20	15/20
caustic soda	1800	900	900	900	13500
	1/10	2/10	3/10		4/10
hydrosulfite conc.	350	700	1200	no addition	1500

The dyeing temperature of the Vat Acid Procedure should be the same as usual for different dyestuffs at the beginning of the process but can be increased to a higher degree than usual after 30 to 45 minutes in order to afford better penetration and more complete exhaustion.

REPRESENTATIVE FORMULA

Furnished by
Dr. Christ, I. G. Farben Works, Leverkusen

Dyed on a "KRANTZ"-machine, System Hulsenlos, 1200 liters content of the liquor. A batch of 91 kilos staple-fiber twining had to be dyed with a combination of

1.65% Indanthrene Blue RSN Powder
0.38% Indanthrene Dark Blue BOA Powder f.f.d.
0.06% Indanthrene Grey M Powder f.f.d.
0.07% Indanthrene Brilliant Violet RR Powder f.f.d.

to a dark blue.

91 kilos of staple-fiber cross-reeled cops, 1200 liters.

Stock vat:

1500 g Indanthrene Blue RSN Powder
300 g Indanthrene Dark Blue BOA Powder f.f.d.
50 g Indanthrene Grey M Powder f.f.d.
60 g Indanthrene Brilliant Violet RR Powder f.f.d.
2 kilos of Setamil WS
6 liters caustic soda 38° Be
2 kilos hydrosulfite conc.
200 liters of water at 65° C.

To be vatted for 10 minutes at 60° C.

Dye-liquor 60° C:

1.2 kilo Setamol WS
1.2 kilo Peregal OK
stock vat
9 liters of Acetic acid 40%

The vat acid was obtained in a clear, blue solution with a red cast. Before the first addition of caustic and hydrosulfite the material was impregnated for 10 minutes with the vat acid solution.

In intervals of 10 minutes each the following was added:

After this, the temperature was increased to 75° C. and dyed for 15 minutes.

A far reaching exhaustion of the bath took place until the fourth addition of caustic (about 50 per cent) and 10 minutes after the last addition of caustic the bath was completely exhausted.

REPRESENTATIVE FORMULA

"KUPENSAURE"
(Vat Acid Procedure)
For Obermaier Package Machine
Test Run made in United States, 1946

COLOR: Vat Navy

COUNT: 38/2 Combed Peller Cotton Yarn

YARN WEIGHT: 10 pounds—Dye & Chemicals figured on weight of yarn. Liquor ratio—1 to 10

After yarn has been wet out, add

1% Nekal NF
1% Igepon T Gel
} to machine, circulate 15 minutes at 100° F. before adding dye.

Make a Stock Vat Reduction of:

6.00% Indanthrene Navy Blue BRP Paste
3.00% Indanthrene Dark Blue BOD Paste
2.00% Caustic soda
2.00% Sodium hydrosulfite
0.80% Nekal NF

Vat 10 minutes at 140° F. then, before adding dye to machine, bring the stock vat to a pH of 5.5 by adding 600 cc., or the required amount of acetic acid 40 per cent. When the pH of 5.5 has been

obtained the dye is added to the machine as follows:

Add 1/3 dye to machine at 12:00 o'clock OUTSIDE-IN
Add 1/3 dye to machine at 12:10 o'clock INSIDE-OUT
Add 1/3 dye to machine at 12:20 o'clock OUTSIDE-IN

Make a solution of caustic soda and sodium hydrosulfite using: 6.00 per cent caustic soda and 6.00 per cent sodium hydrosulfite.

Make solution of 3000 cc. with water.

Start continuous flow of caustic soda and sodium hydrosulfite solution at 12:30 o'clock to flow gradually until 1:00 o'clock.

Run until 1:45 o'clock—check and drop.

FINISH

0.75% Sodium hydrosulfite wash—100° F.—10 minutes
Running wash—10 minutes
Cold wash —10 minutes
1.00% Sodium perborate—120° F.—20 minutes
Cold wash —10 minutes
1.00% Olive Soap } 180° F.—30 minutes
0.50% Raycomine }
Hot wash—140° F.—15 minutes
Cold wash —10 minutes
2.00% Olive oil—100° F.—15 minutes

Dyeing temperatures:

Start at 100° F. — 12:00 o'clock
Raise to 140° F. by 12:45 o'clock
Raise to 165° F. by 1:05 o'clock

Timer adjusted to 12:00 o'clock at beginning of all operations regardless of time of day.

III. Water Soluble Leuco Vats:

It was learned from Mr. Stierwalt of the I. G. Farben Works Technical Organization at Leverkusen that the stable water-soluble ester salts of the leuco compounds of indigoid and anthraquinonoid vat dyestuffs have been used for dyeing cotton and spun rayon on both packages and beams in Germany to a much larger extent than they have ever been used in this country.

These colors are sold in Europe under the trade names of Indigosol, Tinosol and Anthrasol and in the United States as Indigosol and Algosol dyes.

As a rule due to increased cost, only light shades are dyed with the leuco vats. The higher cost of heavy shades making their use almost prohibitive.

Mr. Stierwalt furnished formulas shown below with the use of ammonia and acetic acid in the dyebath which is a new approach to the problem of leuco vat color application:

REPRESENTATIVE FORMULA

COLOR: Algosol Green
COUNT: 40/1 Combed Peeler Cotton Yarn
YARN WEIGHT: 10 pounds—Dye and Chemicals figured on weight of yarn
MACHINE: Obermaier
LIQUOR RATIO: 1 to 13

Procedure

After yarn has been wet out, add

1.00% Nekal NF
0.50% Ammonia 25%
2.30% Acetic Acid 56%
1.00% Retardine
} to machine. Circulate 10 minutes at 75° F.

Add ½ of dye and chemicals below. Run 2 minutes Outside-In:

0.40% Algosol Green IBW Paste—Colour Index 1101
0.32% Algosol Brown IBR of Powder—Prototype 118
0.10% Algosol Blue IBC Paste—Colour Index 1114
1.00% Sulfonated Castor Oil 50%

Add remaining ½ of dye and chemicals. Run 2 minutes Inside-Out, then shift valve at regular intervals. Circulate 11 minutes at 75° F. Raise temperature to 95° F. and run 15 minutes.

Add: 10.00 per cent sodium sulfate and run 30 minutes longer. Drop bath.

DEVELOP WITH

0.60% Sodium Nitrite
5.00% Sulfuric Acid 66° Be
} Run 10 minutes cold
Circulate 2 min. ..... Outside-In
2 min. ..... Inside-Out
4 min. ..... Outside-In
2 min. ..... Inside-Out

Drop developing bath and give cold wash—10 minutes
Drop bath and give 1.00% soda ash wash, 110° F.—10 minutes
Drop bath and give cold wash—10 minutes.

FINISH

1.00% Olive soap flakes }
0.50% Igepon T Gel } 180° F.—30 minutes

Hot wash—140° F.—15 minutes
Cold wash—10 minutes

ALGOSOL DYEING CHART

Add Spring at..... 11:50—75° F.
Add ½ dye at..... 12:00—Outside-In
Add ½ dye at..... 12:02—Inside-Out
12:04—Outside-In
12:08—Inside-Out
12:12—Outside-In
Allow temperature to raise to 95° F. by 12:30..... 12:22—Inside-Out
12:27—Outside-In
Add salt at 12:30..... 12:32—Inside-Out
12:34—Outside-In
12:40—Inside-Out
12:45—Outside-In
12:55—Inside-Out
1:00—Outside-In

DROP BATH
—NO COLD WASH—

Sodium Nitrite
Sulfuric Acid 66° Be
} Run 10 minutes cold
Circulate 2 minutes..... Outside-In
Circulate 2 minutes..... Inside-Out
Circulate 4 minutes..... Outside-In
Circulate 2 minutes..... Inside-Out

Cold wash ..... 10 minutes
Soda ash wash 110° F..... 10 minutes
Cold wash ..... 10 minutes
Soap 180° F..... 30 minutes
Hot wash 140° F..... 15 minutes
Cold wash ..... 10 minutes

IV. Rayon Cake Dyeing:

The I. G. Farben Rayon Plant at Rottweil was visited the last of November 1945 and Dr. Diem was interviewed with reference to a new stainless steel rayon cake dyeing machine. Dr. Diem stated that in 1938 or 1939 he began experiments with an Obermaier closed kier type of package dyeing machine of approximately 20 kilo capacity of rayon cakes weighing 400 grams each. In an effort to dye cakes of larger weight he began experiments with a stainless steel machine of his own construction which was rectangular in size with an open top, placing the cakes on spindles, one on top of each other to the height of 6 to 9, each cake being placed in a metal holder with round discs between. The cakes are first wet out by hand before loading on the spindle in order to overcome the difficulty caused by the swelling of rayon when it is first wet. After the spindles are all loaded, pressure is exerted from the top of the spindle so that each cake will be sealed to the disc above, thereby ensuring the circulation of the dye liquor only through the yarn and not between cakes. Trials were made with circulation of dye liquor from both inside to outside of the cake and vice versa but it was found that better results were obtained with the circulation of the dye from the inside only.

Trials were also made using discs that were perforated and discs of plain stainless steel material and it was found that just as good results were obtained using the unperforated discs and possibly better results. The cakes were 13 cm high each when first placed on the spindles and 11 cm each after pressing from the top. The dye liquor was pumped from the bottom of the spindles with a circulation of from 250 to 350 liters of liquor per cake per hour at pressure of 1.2 to 1.4 atmospheres. Experiments were made with cakes of 400 grams, 500 grams, 600 grams and finally 1000 grams each in weight and Dr. Diem claimed that excellent level dyeings were produced on all of the different sizes, using all types of dyes such as vat, developed, direct, naphthol and sulfur, etc. One machine of 144 cakes capacity was constructed using a pump of 125 mm diameter size and 20 HP motor. This machine, using the 1000 gram weight cakes has a capacity of 316.8 pounds. Another machine constructed with twice the capacity of cakes

or 633.6 pounds with 2 pumps of the same size as in the 144 cake machine.

These two machines, as well as the small Obermaier machine, were inspected but unfortunately the plant was not in operation on account of the lack of coal and chemicals needed for the production of rayon. However, cakes that had been dyed previously were shown which were dyed with the various types of dyestuffs mentioned above and all appeared to be evenly penetrated.

Dr. Diem furnished a complete set of 17 drawings showing all details of the I. G. Rayon Cake Dyeing Machine. A drawing of a new machine developed by Obermaier & Co. was secured also. This machine circular in shape, with an open top has a capacity of 102 cakes with 6 cakes per spindle, uses a pump of 125 mm diameter and 20 HP motor. Reproductions of all 18 drawings can be obtained at cost from the Office of the Publication Board, U. S. Department of Commerce, Washington, D. C.

The following recipes of representative dyeings were furnished by Dr. Diem and although they show dyeings of 22 kilograms and 80 kilograms size only, using cakes of 550 grams each, it was contended by Dr. Diem that the same formulas worked equally well on the larger size machines using cakes up to and including the 1000 gram size.

RECIPE FOR VAT LIGHT GREEN

40 cakes of 550 g—22 kg.
Dye liquor 340 liters
Ratio 1 : 15

1) *Preparation of stock vat:*

24 g Indanthrene Yellow 5GK and 16 g Indanthrene Turquoise Blue 3GK are stirred into 8 liters of water 50° C. with an addition of 200 cc. caustic soda (35 per cent) and 200 g sodium hydrosulfite. The vat is allowed to stand for 15 minutes.

2) *Preparation of the dyebath:*

340 l. of water of 35° C. are supplied with 1140 cc. caustic soda (35 per cent), 1 kg sodium hydrosulfite and 1 kg Peregal 0.

3) *Dyeing:*

The cakes are first treated with the preparation bath (2) for 15 minutes at 35° C. The stock vat is added and the bath allowed to stand until clarified. Dyeing is done for 15 minutes at 35° C. and afterwards for an hour and 30 minutes at 60° C. After that rinse cold for 30 minutes and soap for 20 minutes at 80° with 1 g olive oil soap per liter; for finishing treat for 1 hour in a bath with 2 g Soromin SG per liter at 40° C. The cakes are removed, centrifuged for 10 minutes and dried.

RECIPE FOR VAT BORDEAUX

40 cakes of 550 g—22 kg.
Dye liquor 340 liters
Ratio 1 : 15

1) *Preparation of stock vat:*

800 g Indanthrene Rubine B, 200 g Indanthrene Red CC and 134 g. Indanthrene Red Brown 5 RF are pasted up with 1.8 liters sulfonated castor oil and stirred into 40 liters of water 60° C. with an addition of 2720 cc. caustic soda (35 per cent) and 680 g sodium hydrosulfite. The vat is allowed to stand for 30 minutes.

2) *Preparation of the dyebath:*

300 l. of water of 35° C. are treated with 1.36 l. caustic soda 35 per cent and 680 g sodium hydrosulfite and 1.36 l. Peregal 0. ("sharpened previously").

3) *Dyeing:*

The cakes are treated for 15 minutes with the preparation bath (2) sharpened previously at 35° C. and removed from the bath again. While stirring, the stock vat is added to the dye bath and the bath allowed to stand for 5 minutes. The cakes are immersed into the dyebath and at first dyed for half an hour at 35° C. and another half hour at 50° C. and than for 2 hours at 60° C. After dyeing for 1 hour and 30 minutes 340 g sodium hydrosulfite are added. In connection rinse cold for 2 hours; after that 340 g sodium perborate are added to the vat and treated for 30 minutes at 50° C. After that soaping goes on at 80° C. with 1 g olive oil soap per liter and as an aftertreatment with Soromin SG at 40° C. (2 g Soromin SG per liter) for 15 minutes follows. The cakes are removed, hydroextracted for 10 minutes and dried.

RECIPE FOR VAT MARINE BLUE

144 cakes of 550 g—80 kg
Dye liquor 960 liters
Ratio 1 : 12

1) *Preparation of stock vat:*

2.88 kg Indanthrene Marine Blue R 8015 and 720 g Indanthrene Marine Blue G 8015 are pasted up with 12 liters of sulfonated castor oil and treated with 240 l. of water 60° C. with an addition of 7.2 l. caustic soda and 2.4 kg sodium hydrosulfite. The vat is allowed to stand for 20 minutes.

2) *Preparation of the dyebath:*

720 liters of water 20° C. are treated with 2 l. caustic soda (35 per cent), 2 kg sodium hydrosulfite and 10 l. Peregal 0. ("sharpened previously").

3) *Dyeing:*

The cakes are treated for 15 minutes in the preparation bath (2) at 20° C. The stock vat is added and dyeing is carried out first at 20° C. for an hour and after that 1 hour at 40° C. The dyebath is dropped and a so-called blind vat is prepared by adding 9.6 l. caustic soda (35 per cent), 2 kg sodium hydrosulfite and 4 l. Peregal 0. The goods are treated for 3 hours at 80° C., the bath dropped, and rinsed cold for 30 minutes. After that oxidation is carried out for 1 hour and 30 minutes (adding 3 l. hydrogen peroxide 35 per cent). Rinse cold for 30 minutes and soap for 20 minutes at 80° (1 g olive soap per liter), rinse 20 minutes at 60° C. The cakes are removed, hydroextracted for 10 minutes and dried.

RECIPE FOR DIAZO BLACK

144 cakes of 550 g—80 kg.
Dye liquor 960 l.
Ratio 1 : 12

1) *Dyeing:*

5.6 kg Sambesi Black V are dissolved in 20 l. of water at 80° C. and added to the stock vat while stirring well. The cakes are dyed first at 80° C. for 30 minutes, 10 kg sodium sulfate (dissolved) are added and dyeing goes on for 1 hour at 80° C. Another 10 kg sodium sulfate are added and dyeing is finished after 1 hour. Rinse cold for 15 minutes.

2) *Diazotation:*

3 kg nitrite (dissolved in cold water) and 6 liters concentrated hydrochloric acid are added. The cakes are immersed into the diazotation bath at 20° C. and diazotized for 30 minutes. After that, rinse cold for 30 minutes.

3) *Developing:*

1.5 kg Developer H are dissolved in 10 liters of water at 80° C. and added to the vat. The cakes are placed into the developing bath and developed at 20° C. for 30 minutes. Rinse cold 30 minutes. Soap 20 minutes at 50° C. (1.5 g olive oil soap per liter) and after treat for 15 minutes at 40° C with Soromin SG (2 g per liter). The cakes are taken out, hydroextracted for 10 minutes and dried.

RECIPE FOR NAPHTHOL RED

144 cakes of 550 g—80 kg.
Dye liquor—960 liters
Ratio 1 : 12

1) *Starting solution:*

600 g Naphthol AS—TR are pasted up with 1.2 l. sulfonated castor oil. 3 liters caustic soda (35 per cent) are added and 60 l. boiling water are poured over. Boil up until the solution is clear.

2) *Dyeing bath:*

960 liters of water are sharpened previously to 55° with an addition of 2.5 l. caustic soda (35 per cent). The starting solution (1) is filtered and added to bath. 3) The cakes are impregnated at 50° for 1 hour and 30 minutes, taken out and hydro extracted for 20 minutes.

4) *Developing:*

800 g Fast Scarlet TR—Base are stirred in 20 liters of cold water. The solution is treated with 800 cc. concentrated hydrochloric acid. While stirring well 350 g sodium nitrite—dissolved in 2 l. of cold water—are added slowly; the solution is allowed to stand for 30 minutes and neutralized with 600 g sodium acetate. 150 cc. acetic acid 50 per cent are added. 5 kg sodium acetate are added to the stock vat. The cakes are immersed into the developing bath at 15° C. and developed for 45 minutes. After that rinse cold for 45 minutes and soap three times—1 hour each time—at 80° (2 kg. Igepal C). After every soap bath rinse cold for 20 minutes. The cakes are taken out, hydro-extracted for 10 minutes and dried.

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Bibliography of Color —

(Concluded from Page P412)

Hey, R. Wilkinson & E. F. Bradbrook, J. Chem. Soc. *1945*, 409; the last two deal in part with the greens of the series. A 1944 article on Tyrian purple may be found in Analyst *70*, 62 (1945). Three papers which were part of a Symposium on the Application of Pigments to Textiles may be found in JSDC, vol. *61;* they are A. H. Barton, p. 85, C. Hobday, p. 87, and R. J. Hannay, p. 88; and a lecture by A. McLean, on pigment printing and dyeing, past, present and future, is in ADR *34*, 311. A patent on a paint flatting agent is U. S. Pat. 2,370,648. We have mentioned in Section 5 Granville's paper on spectrophotometry in evaluating colorants. L. Koch, Amer. Ink Maker *24*, No. 1, 27, 29, 31, discusses the systematic identification of organic ink colors and their bases; and P. L. de Araujo Feio, Rev. soc. brasil. quim. *14*, 29, publishes a review and classification of invisible inks.

Some miscellaneous papers in this section, some of them (as the first three mentioned) of considerable interest, are: D. Nickerson, K. L. Kelly & K. F. Stulz, JOSA *35*, 297, the color of soils; A. H. Pfund, JOSA *35*, 611, the identification of gems; W. Colbert & N. J. Kreidl, JOSA *35*, 731, unusual colors produced by uranium in glass; and J. H. Archibald, Text. Colorist & Converter *67*, 772, color today loses nothing to volume production. This section may be completed by adding three patents: Brit. Pat. 565,824, decolorization of water; W. Geffken & E. Berger, U. S. Pat. 2,366,516, low-reflecting surface; and Radio Corp. of America, Brit. Pat. 570,717, anti-reflection coatings.

8. Color in War (Blackout, Camouflage, Fluorescene and Phosphorescence).

The following papers dealing with luminescence may be mentioned: J. A. Radley, Paint Manuf. *15*, 115, 144, fluorescent lacquers; P. P. Feofilov, Compt. rend. acad. sci. URSS *44*, 147 and Doklady Akad. Nauk SSSR *44*, 159 (Chem. Abstr. *39*, 4007; 1945), polarized fluorescence of dyestuffs in rigid solutions; P. Ellinger, Nature *155*, 319, nicotinamide methochloride and its fluorescent derivatives; E. J. Bowen, J. Chem. Physics *13*, 306, fluorescence of naphthacene in anthracene; D. Bertrand, Compt. rend. *220*, 654, new theory of the fluorescence of organic substances; R. P. Teele, J. Research Hant. Bur. Stand. *34*, 325, photometer for luminescent materials; W. H. Byler & C. Carroll, JOSA *35*, 258, method for determining the chromaticity of fluorescent material; A. H. Jackson, Indus. Finishing *21*, No. 8, 52, 54, luminous paint; M. A. Heikkila, Text. Colorist & Converter *67*, 564, pigmented textiles excited to phosphorescence; J. T. Randall & M. H. F. Wilkins, Proc. Roy. Soc. *184*, 347, phosphorescence of various solids; J. T. Randall & M. H. F. Wilkins, Proc. Roy. Soc. *184*, 365, 390, phosphorescence and electron traps (I, study of trap distributions; II, interpretation of long-period phosphorescence); G. F. J. Garlick & M. H. F. Wilkins, Proc. Roy. Soc. *184*, 408, short-period phosphorescence and electron traps. The following patent may also be mentioned: National Marking Machine Co., Ltd., Brit. Pat. 566,317, fluorescent identification-marking of fabrics.

In connection with camouflage, there is an anonymous note, "animal concealment and flash coloration," dealing with the work of J. E. Marson, in Nature *155*, 232. There are also an article by H. C. Bryson, Oil Color Trades J. *107*, 520, camouflage and chlorophyll; and a patent to W. E. Meyer & R. M. Roberts, U. S. Pat. 2,371,458, improvement in machine for fabricating camouflage.

Miscellaneous articles include an anonymous note in Text. Colorist & Converter *67*, 575, 588, outlining the war work and past war plans of the Textile Color Card Association of the U. S.; an article by B. Y. Sveshnikov & P. P. Dikun, J. Phys. Chem. USSR *19*, 289, on the chemiluminescence of lucigenin; and finally an article on colored signal smokes (a demonstration) by W. F. Kieffer & J. M. Resko, in J. Chem. Education *22*, 385.

EMPLOYMENT REGISTER

This column is open for four insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Textile Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers, who can obtain further information through the code numbers from the Secretary.

46-5

Education: Lowell Textile School, Night, Chemistry, 1942.
Experience: Hosiery dyeing and finishing.
Age 29; married; references.

46-7

Education: Graduate, Bradford Durfee Textile School, 1933.
Experience: Five years as Textile Engineer, developing Non-woven fabrics.
Age 31; married; 3 dependents; references.

46-9

Education: Graduate, Philadelphia Textile Inst., Chem. & Dye.
Experience: Inspector, Quartermaster Corps. Staff Sgt., U.S.A.A.F., Sta. Chief, Meteorology.
Age 24; married; references.

46-10

Education: B. S., Pratt Inst.
Experience: Leather finishing. U. S. Army Medical Corps, Pharmacist, C. W. S. Instructor. Lab. application work on textile chemical specialties. Development of colors in laboratory and pilot plant. Interested in tech. sales service.
Age 31; single.

46-11

Education: PhD. Chem. Engg., Geneva, Switzerland.
Experience: Chief Chemist of Textile Mills, silk and cotton.
Age 57; single; references.

46-12

Education: Graduate New Bedford Textile School, 1945.

Experience: Laboratory technician, chemical, and physical testing.
Woman, age 20, single: references. Employment near Atlanta, Ga., preferred.

46-14

Education: B.S., Brooklyn College, 1934. courses in New York Textile High School, Brooklyn Polytechnic Inst., Columbia University.
Experience: Textile Technologist and Chief Chemist, analytical and testing.
Age 34; married; references.

46-15

Education: High school.
Experience: Leather and fur dyeing, 28 years.
Age 52; married.

CALENDAR OF COMING EVENTS

SOUTH CENTRAL SECTION:
Meeting (Tentative): September 21
(Patton Hotel, Chattanooga, Tenn.)

SUB-COMMITTEES
Meetings: September 26
(Hotel Commodore, New York City)

COUNCIL:
Meeting: September 27
(Hotel Commodore, New York City)

RESEARCH COMMITTEE:
Meeting: September 27
(Hotel Commodore, New York City)

NEW YORK SECTION:
Meeting: October 18
(Swiss Chalet, Rochelle Park, N. J.)
Meeting: November 22

PIEDMONT SECTION
Meeting: October 26
(Charlotte, N. C.)

NATIONAL CONVENTION:
Silver Jubilee Convention: December 12, 13 and 14.
(Hotel Statler, Boston, Mass.)

Silver Jubilee Convention

HOTEL RESERVATIONS

PLANS for the Silver Jubilee Convention in Boston are progressing under the leadership of George O. Linberg, General Chairman. About September 1st, each member of our Association will receive a card on which he can specify the type of hotel accommodation desired. All requests for hotel reservations are to be handled by the Housing Bureau, 80 Federal Street, Boston, Mass. Reservations will be acknowledged from this office and assigned to various hotels which will, in turn, give a direct confirmation on each reservation. We would suggest that members do not contact the hotels directly on room reservations. The Committee feels that ample hotel space will be available.

Auspices: Northern New England Section

Headquarters: Hotel Statler

December 12, 13 and 14, 1946

Boston, Mass.

The Dyeing of Direct Dyes on Cotton

(Continued from Page 406)

rather higher accuracy is obtained, for the standard error on any determination is 1.1 per cent actual.

TABLE III
Rate of Dyeing of Chlorazol Dark Green PL 125 on Cotton Yarn in 60 : 1 Liquor

Time (min.)	Dye on Fibre (%)						Range (actual)	Dye on Fibre (mean %)	Range as % of Dye on Fibre
	A	B	C	D	E	F			
1	15	17	15	17	15	15	2·0	15·3	13·1
2	23·5	25·5	24	25·5	24	25·5	2·0	24·7	8·1
4	35·5	37·5	36	39·5	37·5	38	2·5	37·5	6·7
8	51·5	51	49·5	53·5	51·5	51·5	4·0	51·4	7·7
12	60·5	60	67·5	62	60·5	61·5	4·5	60·2	7·5
20	66·5	66	67	67·5	67	67	1·5	66·8	2·2
30	69·5	69·5	70·5	71	70	70·5	1·5	70·2	2·1
45	71·5	71·5	71	72	71	75	3·75	72·2	5·2
						Mean:	2·72	49·8	5·5

Using this apparatus, curves were determined on a number of direct cotton dyes on 2/30s bleached unmercerized cotton yarn with additions of 0 per cent, 8 per cent and 16 per cent calcined Glauber's salt.

Method of Expressing Rate-of-dyeing Data

The rate-of-dyeing curves obtained in this way on both types of apparatus are very similar in shape for different dyes and typical examples are given in Figs. 6, 7, 8 and 9.

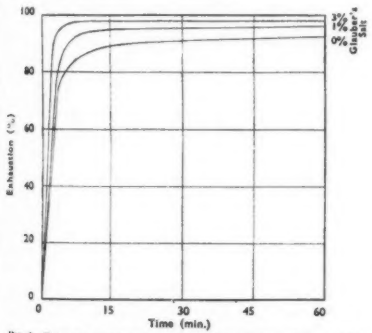


FIG. 6—Rate-of-dyeing Curves of a Salt-insensitive Dye in 5 Vol. 1% Chlorazol Bordeaux BS

Since six curves have been measured for each of about 60 dyes, it is obvious that the presentation of all the data in graphical form would occupy an inordinate amount of space. Consequently, the results have been expressed in terms of the two functions already mentioned, viz. the equilibrium exhaustion and the time of half-dyeing. Fortunately, in nearly all the dyes examined it appeared that equilibrium was reached in the normal dyeing time, for the exhaustion did not vary appreciably over the last 15-30 min. of dyeing and, consequently, it was easy to determine the equilibrium exhaustion. Since the mechanism of dyeing of all the dyes is probably the same, it is reasonable to anticipate that the shape of the dyeing curves will follow the same law and,

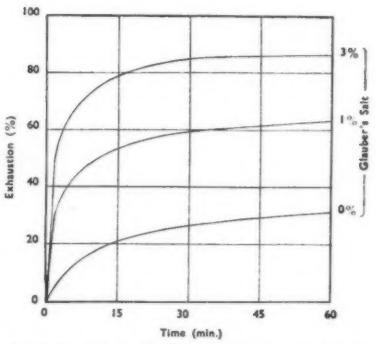


FIG. 7—Rate-of-dyeing Curves of a Salt-sensitive Dye in 5 Vol. 1% Durazol Fast Blue 4GS

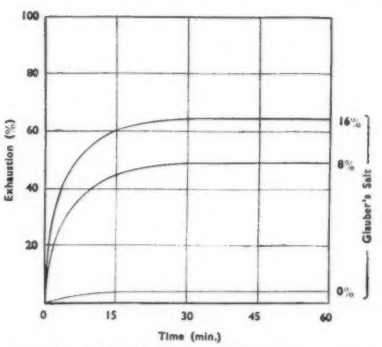


FIG. 8—Rate-of-dyeing Curves of a Salt-sensitive Dye in 60 Vol. 0·5% Chlorazol Sky Blue GW400

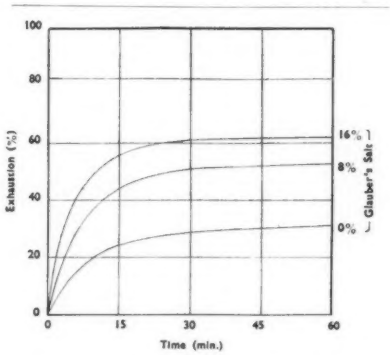


FIG. 9
Rate-of-dyeing Curves of a Dye with Low Salt-sensitivity in 60 Vol. 2% Chlorazol Black E 200

consequently, it is justifiable to regard the time of half-dyeing as a measure of the relative overall rate of dyeing of different dyes. *"Time of half-dyeing" as used in this communication should be carefully distinguished from the use of the same words by Boulton.* In the present communication the words refer merely to the time required for half that exhaustion to be obtained which will be obtained at equilibrium, and the figure involves no assumption as to the conditions of measurement. As used by Boulton, on the other hand, the words have a more definite and limited significance and refer to the time required for the dyebath to attain 25 per cent exhaustion when the final exhaustion will be 50 per cent, these conditions having been attained by suitable selection of the salt concentration.

In the present experiments it was found that the time of half-dyeing for most dyes was rather small, especially in the short liquor. In cases where the time was longer than 1.5 min., it was determined directly by a graphical method from the complete rate-of-dyeing curves. When the time was < 1.5 min., the graphical method becomes inaccurate and, consequently, it was decided to determine these smaller values by use of the hyperbola equation—

$$Kt = \frac{1}{E - x} - \frac{1}{E}$$

(x = % of dye absorbed in time, t; E = % of dye absorbed at equilibrium; and K = a constant). This curve fits the rate-of-dyeing data fairly well and, even if it is not a perfect fit, the error involved in using it to calculate the time of half-dyeing is small. The time of half-dyeing ($t_{1/2}$) was calculated from the relationship—

$$t_{1/2} = \frac{1}{EK}$$

In this way it was found possible to estimate the times of half-dyeing down to 0.1 min. For the borderline cases where the time of half-dyeing was of the order of 0.8 to 1.4 min., the calculated values agreed very well with those derived by inspection of the graph.

The accuracy of the derived values of time of half-dyeing and equilibrium exhaustion was also investigated by treatment of the results given in Tables III and IV. With regard to the equilibrium exhaustion, since this is almost established in the majority of cases in 1 hr. dyeing time, the error in this value is the same as the error in the 60 min. point, viz. 2 per cent actual. Even in those cases where equilibrium has not been established, as is the case with the results in Table III, the error should not be very much greater. The estimation of the final exhaustion in these cases was made by applying the hyperbola equation to the 15 and 60 min. points. Thus, applying the equation to the values for the exhaustion at 15 and 60 min. obtained in the first column of Table III gives the value of $E = 77.4$. Applying this treatment to the other four sets of results given in Table III, the corresponding equilibrium values are 80.2 per cent, 79.0 per cent, 78.5 per cent and 83.6 per cent, respectively, giving a mean value of 79.7 per cent and a standard error of 2.4 per cent actual. This again should be quite satisfactory in practice.

With regard to the half-dyeing time, the estimation of accuracy is not so easy. In the first place the results of Table III do not fit a hyperbola very well. Nevertheless, a hyperbola may be drawn, passing through the origin and any two selected points, and from this curve the half-dyeing time may be calculated. Alternatively, the points may be plotted and the curves drawn through them and the half-dyeing time estimated directly. As already stated, this later procedure has been followed for times of half-dyeing longer than 1.5 min. and the former procedure for shorter times. It may be argued that, even if the points do not lie on a hyperbola, the time as determined from the hyperbola passing through the origin and two of the points will not be greatly different from the true half-dyeing time. This assumption may be checked with the results in Table III. The mean equilibrium exhaustion is 79.7 per cent, as already noted. If the mean exhaustion at the individual times is plotted against time, the curve through the points indicates a half-dyeing time of 1.80 min. From the equation of the hyperbola passing through the 3 min. and 30 min. points the time of half-dyeing obtained is 1.94 min., which is 8 per cent greater than the graphical value. By graphical methods the individual sets of results give values of 1.6, 1.9, 1.9, 1.6 and 2.0, respectively, giving an average value of 1.80 min. with a standard error of 0.19 actual or just over 10 per cent. Using the hyperbola formula on the 3 min. and 30 min. points, the results are 2.0, 2.0, 2.3, 1.7 and 1.8 min., respectively, giving an average value of 1.95 min. and a standard error of 0.23 actual or 12 per cent. It thus appears that the time of half-dyeing is much less accurate than the determination of the individual points, having a standard error of about 10 per cent. These remarks for time of half-dyeing apply only to the results obtained with the 5 : 1 liquor-goods ratio. With the 60 : 1 liquor-goods ratio in the rate-of-dyeing apparatus the results are rather more accurate. The times of half-dyeing in the six experiments on Chlorazol Dark Green PL 125 given in Table III were determined by the graphical method and are 4.0, 3.8, 4.0, 3.4, 3.8 and 3.6 min. The mean value is 3.8 min. and the standard error 0.23 min. or 6 per cent. Although the accuracy of this figure is not high, it is probably satisfactory for practical purposes in view of the large tolerances encountered, and in any case it is difficult to see how it could be improved except by very drastic changes in the technique which would make the work much slower and more laborious.

The data obtained are given in Tables IV and V. With some dyes the information is not complete owing to various difficulties which were encountered, e.g. lack of solubility, change of color on exhaustion and change of color with the 60 : 1 liquor-goods ratio in the dyeing apparatus, and difficulties in obtaining a satisfactory calibration curve. In a few isolated cases which were determined at a later date, only the exhaustion was measured and not the rate.

TABLE IV
Cotton Casement Material: Exhaustion and Time of Half-dyeing with a 5 : 1 Liquor-Goods Ratio

Dye	Depth of Shade (%)	Equilibrium Exhaustion (%) 0% Na_2SO_4	1% Na_2SO_4	3% Na_2SO_4	$t_{\frac{1}{2}}$ (min.) 0% Na_2SO_4	1% Na_2SO_4	3% Na_2SO_4
Durazol Fast Yellow GR 200	0·5	65·0	83·0	92·0	1·5	1·1	0·5
Durazol Fast Yellow G 400	0·5	87·0	96·5	99·0	0·4	0·2	0·1
Durazol Fast Yellow 6GS	1·5	78·0	82·1	85·1	0·3	0·2	0·1
Chlorazol Yellow 6GS ...	1·0	—	—	—	—	—	—
Chrysophenine G 200 ...	0·5	39·0	67·0	82·0	0·3	0·2	0·2
Durazol Fast Orange 2G 125	1·0	52·0	73·0	82·0	1·6	1·1	0·4
Chlorazol Fast Orange D 125	1·5	20·0	35·0	46·5	3·5	2·9	1·0
Durazol Fast Orange 4R 150	0·5	42·5	75·0	84·0	3·7	0·7	0·4
Chlorazol Fast Orange R 150	0·5	90·0	93·0	95·0	1·0	0·2	0·1
Chlorazol Orange PO 150 ...	0·5	80·0	92·0	95·0	1·0	0·5	0·1
Chlorazol Brown LF 150 ...	1·5	70·0	77·0	83·0	1·0	0·6	0·4
Chlorazol Brown M 150 ...	0·5	89·0	95·0	97·5	0·8	0·2	0·1
Chlorazol Catechine B 125...	1·5	26·5	30·5	40·0	1·5	1·2	1·0
Chlorazol Catechine GR 150	1·5	55·0	64·0	70·0	0·9	0·8	0·6
Chlorazol Drab RH 125 ...	1·0	77·0	84·0	91·0	1·0	0·6	0·4
Chlorazol Orange Brown X 150	1·0	88·5	92·5	95·0	1·7	1·3	0·8
Chlorazol Bordeaux BS ...	1·0	92·0	95·5	98·0	0·9	0·4	0·2
Chlorazol Bordeaux 6B 150	0·5	81·0	92·5	95·8	0·2	0·1	0·1
Chlorazol Fast Pink BK 200	0·5	32·0	59·0	82·5	6·5	0·9	0·6
Chlorazol Fast Red F 125...	1·0	74·0	89·5	95·0	1·0	0·6	0·2
Durazol Red 2B 150 ...	1·0	41·0	63·0	83·0	0·5	0·2	0·2
Chlorazol Fast Scarlet 4BAS	1·0	77·5	90·5	94·5	1·8	0·9	0·4
Chlorazol Fast Scarlet 4B 150	0·5	95·0	97·5	98·5	0·9	0·2	0·1
Chlorazol Fast Scarlet 8B 125	1·0	83·0	93·0	96·5	2·0	1·0	0·4
Chlorazol Fast Scarlet GS...	1·0	75·0	85·0	91·5	1·5	0·8	0·6
Durazol Fast Rubine B 150	1·0	44·0	75·0	87·0	4·0	2·0	0·8
Durazol Helio B 200 ...	0·5	65·25	86·0	91·5	0·7	0·3	0·2
Chlorazol Fast Helio 2RK 200 ...	0·5	61·0	82·0	90·5	0·3	0·2	0·2
Chlorazol Violet N 125 ...	0·5	73·0	90·5	95·0	2·1	0·7	0·4
Durazol Fast Violet 2BS ...	1·0	10·5	27·5	53·5	2·1	1·0	0·7
Chlorazol Blue B 200 ...	1·0	66·0	81·0	90·0	0·9	0·4	0·3
Chlorazol Blue G 150 ...	1·0	36·0	51·0	71·0	0·6	0·3	0·3
Durazol Fast Blue 3R 200	1·0	41·5	73·0	91·5	1·2	1·5	0·5
Durazol Fast Blue 2R 200	1·0	40·0	72·0	90·0	5·3	3·5	0·9
Durazol Fast Blue G 200 ...	1·0	75·0	87·0	95·0	1·8	0·9	0·6
Durazol Blue 2GN 200 ...	1·0	82·0	92·0	94·0	1·0	0·4	0·2
Durazol Fast Blue 4GS ...	2·0	33·0	65·0	86·5	8·0	2·5	1·3
Durazol Fast Blue 4R 200	0·5	35·0	73·0	92·5	4·5	1·0	0·4
Chlorazol Sky Blue FF 200	0·5	76·5	91·5	95·0	1·4	0·4	0·2
Chlorazol Sky Blue GW 400	0·5	50·2	84·0	94·5	1·7	0·5	0·3
Chlorazol Steel Blue 6B 150	1·0	—	—	—	—	—	—
Chlorazol Dark Green PL125	1·5	81·0	87·0	90·0	1·4	0·6	0·4
Chlorazol Green BN 125 ...	1·5	80·0	90·5	96·0	0·6	0·8	0·8
Chlorazol Green GS ...	1·5	75·0	88·0	92·0	0·7	0·6	0·4
Chlorazol Black BH 200 ...	1·0	82·0	91·5	96·0	0·7	0·4	0·2
Chlorazol Black EN 200 ...	2·0	74·0	80·0	83·0	1·4	0·9	0·7
Chlorazol Black E 200 ...	2·0	78·0	84·0	88·0	0·7	0·6	0·5
Chlorazol Black FF 200 ...	2·0	52·0	59·0	62·0	1·6	1·2	0·9
Chlorazol Black GF 200 ...	2·0	45·0	56·0	61·0	3·1	3·1	2·0
Chlorazol Black JH 200 ...	1·0	81·0	90·5	95·0	0·7	0·4	0·1
Chlorazol Black LF 150 ...	2·5	73·0	79·0	83·0	2·0	1·5	2·2
Chlorazol Black PB 150 ...	2·5	—	—	—	—	—	—
Durazol Grey N 150 ...	0·5	—	—	—	—	—	—
Durazol Grey RG 125 ...	1·0	62·0	79·0	88·5	0·3	0·2	0·2
Durazol Fast Grey B 125 ...	1·0	—	—	—	—	—	—
Durazol Fast Grey GS ...	1·5	75·0	84·0	90·5	1·3	0·4	0·4

TABLE V
Cotton Yarn: Exhaustion and Time of Half-Dyeing with a 60 : 1 Liquor-Goods Ratio

Dye	Depth of Shade (%)	Equilibrium Exhaustion (%) 0% Na_2SO_4	8% Na_2SO_4	18% Na_2SO_4	$t_{\frac{1}{2}}$ (min.) 0% Na_2SO_4	8% Na_2SO_4	18% Na_2SO_4
Durazol Fast Yellow GR 200	0·5	34	65	77	4·2	1·8	17
Durazol Fast Yellow G 400	0·5	34	66	80	2·4	1·9	24
Durazol Fast Yellow 6GS ...	1·5	29	65	74	1·6	1·2	14
Chlorazol Yellow 6GS ...	1·0	14	28	37	1·6	3·2	41
Chrysophenine G 200 ...	0·5	9	29	38	0·6	0·8	16
Durazol Fast Orange 2G 125	1·0	6	32	47	1·6	1·8	20
Chlorazol Fast Orange D 125	1·5	5	22	36	—	—	—
Durazol Fast Orange 4R 150	0·5	13	46	62	4·0	3·4	26
Chlorazol Fast Orange R150	0·5	53	80	85	2·4	1·9	20
Chlorazol Orange PO 150 ...	0·5	30	57	68	1·7	1·6	17
Chlorazol Brown LF 150 ...	1·5	31	56	65	4·0	3·2	36
Chlorazol Brown M 150 ...	0·5	42	71	80	2·0	1·4	18
Durazol Fast Brown BR 150	0·75	39	81	87	—	—	—
Chlorazol Catechine B 125...	1·5	12	24	32	1·0	1·7	14
Chlorazol Catechine GR 150	1·5	24	36	44	—	2·2	14
Chlorazol Drab RH 125 ...	1·0	38	62	71	3·4	4·2	24
Chlorazol Orange Brown X 150	1·0	41	82	89	3·8	3·8	34
Chlorazol Orange Brown 2R 150	1·0	32	49	56	—	—	—
Durazol Fast Orange Brown 2RS ...	1·0	20	48	60	—	—	—
Chlorazol Bordeaux BS ...	1·0	39	71	86	2·8	2·0	19
Chlorazol Bordeaux 6B150	0·5	27	53	64	1·7	1·5	12
Chlorazol Fast Pink BK200	0·5	0	28	—	—	1·4	14
Chlorazol Fast Red F 125...	1·0	26	46	59	2·4	1·4	20
Durazol Red 2B 150 ...	1·0	10	25	34	0·9	0·8	11
Chlorazol Fast Scarlet 4BAS	1·0	23	46	61	6·2	3·6	28
Chlorazol Fast Scarlet 4B 150	0·5	66	84	91	8·0	2·6	22
Chlorazol Fast Scarlet 8B 125	1·0	28	54	67	4·8	2·8	26
Chlorazol Fast Scarlet GS...	1·0	30	53	65	3·6	3·2	24
Durazol Fast Rubine B 150	1·0	12	29	43	—	5·2	26
Durazol Brilliant Red B 150	1·0	8	33	50	—	—	—
Durazol Fast Red 6BS ...	1·0	8	34	50	—	—	—
Durazol Fast Scarlet 2G 150	1·75	18	52	70	—	—	—
Durazol Helio B 200 ...	0·5	16	43	53	2·4	1·2	13
Chlorazol Fast Helio 2RK 200	0·5	18	48	58	1·4	1·0	09
Chlorazol Violet N 125 ...	0·5	32	73	84	4·6	2·0	28
Durazol Fast Violet 2BS ...	1·0	6	13	17	—	2·7	19
Chlorazol Blue B 200 ...	1·0	10	30	42	1·6	0·9	12
Chlorazol Blue G 150 ...	1·0	8	23	34	2·8	1·9	14
Durazol Fast Blue 3R 200	1·0	14	38	49	12·0	3·4	26
Durazol Fast Blue 2R 200	1·0	14	36	49	5·1	3·6	42
Durazol Fast Blue G 200 ...	1·0	15	35	49	2·6	3·6	41
Durazol Blue 2GN 200 ...	1·0	17	44	61	2·0	2·3	26
Durazol Fast Blue 4GS ...	2·0	4	27	39	—	—	60
Durazol Fast Blue 4R 200	0·5	6	34	54	—	2·8	28
Chlorazol Sky Blue FF 200	0·5	23	59	75	9·6	2·2	31
Chlorazol Sky Blue GW 400	0·5	4	48	64	4·8	2·6	17
Chlorazol Steel Blue 6B 150	1·0	5	56	72	4·4	2·0	18
Chlorazol Dark Green PL 125	1·5	34	58	66	1·7	2·6	27
Chlorazol Green BN 125 ...	1·5	66	78	86	4·4	5·9	40
Chlorazol Green GS ...	1·5	14	36	51	2·4	1·0	10
Chlorazol Black BH 200 ...	1·0	25	51	66	1·3	0·9	07
Chlorazol Black EN 200 ...	2·0	29	56	64	3·7	2·6	27
Chlorazol Black E 200 ...	2·0	33	53	62	3·0	2·8	22
Chlorazol Black FF 200 ...	2·0	25	41	50	1·6	2·0	20
Chlorazol Black GF 200 ...	2·0	19	48	62	1·2	2·6	33
Chlorazol Black JH 200 ...	1·0	34	49	65	3·9	1·9	18
Chlorazol Black LF 150 ...	2·5	34	54	63	6·8	3·7	34
Chlorazol Black PB 150 ...	2·5	23	47	58	3·2	3·1	28
Durazol Grey N 150 ...	0·5	45	66	72	1·4	1·6	17
Durazol Grey RG 125 ...	1·0	15	33	43	1·6	1·6	16
Durazol Fast Grey B 125 ...	1·0	12	33	47	2·6	5·6	33
Durazol Fast Grey GS ...	1·5	9	33	47	1·0	2·6	28
Durazol Fast Grey VGS ...	1·5	30	54	70	12·0	6·0	30
Chlorazol Diazo Black DB 150	2·5	20	37	48	—	—	—
Chlorazol Diazo Black 3B 150	2·5	21	37	48	—	—	—

A general analysis of the results given in Tables IV and V leads to the following conclusions—

(1) The effect of increasing salt concentration or reduction in liquor length is invariably to increase the equilibrium exhaustion.

(2) The effect of reducing the liquor length is in general to increase quite considerably the rate of dyeing. Some few exceptions to this rule are apparent when comparing dyeing rates without added salt.

(3) The effect of increasing salt concentrations on the rate of dyeing varies somewhat. With a 5 : 1 liquor-goods ratio the effect over the range of salt con-

centrations here employed is to increase the rate of dyeing, apart from three exceptions which showed maximum, minimum and decreasing rates, respectively. With the 60 : 1 liquor-goods ratio, 27 dyes showed an increase in rate with an increase in salt concentration, 12 a decrease, 2 no change, 9 a maximum and 3 a minimum rate with intermediate salt concentration. Similar apparently anomalous results in long liquor lengths have been obtained by other observers. Poor solubility as the salt addition is increased may also account for a decrease in rate of dyeing, either continuously as more salt is added, or after reaching a maximum.

The Range of Dyeing Rates

This range was much less than has been observed in previous work of this nature. Boulton, for example, working with viscose rayon obtained rates of dyeing varying from 0.07 to 280 min., whereas the greatest range obtained in the present work was from 0.2 to 8 min., observed using a 5 : 1 liquor-goods ratio without added salt. This difference in ranges was ultimately found to be attributable almost entirely to the different conditions of test employed. The nature of the material and the percentage shade employed contribute to the difference, but the main factors are probably the liquor lengths and the dyeing method. The effect of the former is particularly manifest in the 5 : 1 determinations, for reduction in liquor length is known to increase rate of dyeing very considerably in all dye-fiber systems hitherto examined, and apparently it also reduces the differences between individual dyes. The adoption of a circulation technique for estimating rate of dyeing when using a 60 : 1 liquor-goods ratio probably has a similar effect in reducing the differences. It seems almost certain that dyeing rates are only comparative and must depend upon the nature of the dyeing machinery employed, so that the most which can be hoped for in any series of measurements is that the order of dyes according to their rates will remain constant under all mechanical variations in the condition of dyeing. It is thus essential that the rates shall be at least reproducible under the standard conditions employed in this investigation, and the statistical analysis already described indicates that this is the case.

Comparison of the Results Obtained with the Two Liquor-Goods Ratios

When a comparison of the dyeing properties of the dyes is made with respect to the two liquor-goods ratios, considerable divergencies between the order under the different conditions is apparent, although if the dyes are listed in order of equilibrium values or times of half-dyeing in a 60 : 1 liquor, there will be a general agreement with the corresponding order of values in a 5 : 1 liquor. This behavior of the direct dyes is not necessarily to be regarded as an anomaly, since there are so many factors which may produce a different behavior when the liquor-goods ratio is altered. The most important factor is probably the salt content of the dyes. Even with the concentrated brands of dyes used in this work, the salt content will produce a much greater exhaustion in the absence of added salt in the 5 : 1 liquor than in the long liquor. Experiments with specially purified salt-free dyes have shown that the degree of exhaustion which is obtained in a short liquor can be predicted from a knowledge of the dyeing properties of the dye in a long liquor and *vice versa*, provided that the salt concentration is the same at both liquor lengths.

The Uses of Rate-of-dyeing Data

(a) As a Guide to the Compatibility of Dyes in Mixtures—The primary objective of rate-of-dyeing measurement is to obtain information which will provide a guide to the selection of dye mixtures behaving compatibly in practice, and, accordingly, tests have been carried out to determine the value of the information given in Tables IV and V. In order to do this, it was decided to examine a number of binary dye mixtures and to see whether their behavior in practice could be predicted from the available data. In practice, the compatibility of a pair of dyes depends upon four factors, viz.—

(1) The shades of the components.

(2) The levelling properties of the components.

(3) The dyeing machinery employed and particularly the liquor-goods ratio and speed of circulation.

(4) The rate of exhaustion of the components *in the mixture.*

The importance of the first of these factors is self-evident, for obviously a partial separation of the components of a mixture will be the less noticeable the smaller the shade difference betwen the individual dyes. Further, if the dyes concerned are of a high order of levelling power or if the dyeliquor is absorbed mechanically and uniformly, prior to dyeing, there should be no need to bother about the question of compatibility. This latter effect takes place to a considerable extent in jig dyeing and explains why dyes may be more compatible on the jig than in other dyeing processes. However, where conditions are not favorable to the production of level dyeings with mixture shades, then even absorption of the components is essential, i.e. the rate of exhaustion of all components *in the mixture* must be the same. Even with level dyeing dyes, uniform absorption is an advantage as it avoids delay in matching shades.

In a full-scale dyeing operation, all these factors are operating at the same time and, in particular, it is impossible to disentangle effects due solely to rate of dyeing from those due to levelling or migration and occurring at the same time. Consequently, it was felt that a normal dyeing operation was not the most satisfactory means of testing the value of rate-of-dyeing data, and that what was needed was some test which would isolate the dyeing rate effects from other disturbing factors. Such a test is available in the so-called "dip test," which consists in dyeing successive pieces of material for short times in the same dyebath and observing the sequence of color changes. This test clearly indicates which of two dyes in a binary mixture is absorbed by the fiber first and is extremely sensitive to small differences in dyeing behavior. This point should perhaps be emphasized, as it will be observed from the results that comparatively few mixtures are compatible by this test and many mixtures which are used in practice by virtue of their good levelling power show up badly under these conditions.

Dip tests were carried out on over 300 binary combinations of dyes, under conditions similar to those used in the 60 : 1 liquor-goods ratio measurements, except that, instead of circulating the dyeliquor through a mass of cotton yarn, dyeings were carried out on cotton limbric in conical dyepots. Successive dyeings were carried out in the same dyebath at 85°-90° C. for intervals of 1, 2, 4, 8, 16, 30 and 60 min., or until exhaustion was complete. Dyeing for increasing periods of time was preferred to dips of the same duration for two main reasons, viz. (1) that, in general, successive dyeings are more nearly equal to each other in depth of shade, and (2) that less material is required and, with a reduction in the number of dips, less dyeliquor is removed mechanically from the dyebath. In addition, the sensitivity of the test is reduced somewhat as compared with a similar test using dips of the same duration, e.g. 2 min. in each case, and this reduced sensitivity is a better guide to practical working conditions. The percentage shade of dye employed was the same as in the original rate-of-dyeing determinations and the addition was also made, as before, of 16 per cent commercial calcined Glauber's salt. In order to maintain a liquor length as nearly as possible constant at 60 : 1,

the cotton limbric was wetted out, prior to dyeing, in a blank dyebath, also at 85°-90° C. and containing Glauber's salt only, squeezing well before and after dyeing to remove surplus liquor.

The combinations chosen were practically all of primary or complementary colors, viz. yellows with reds, violets and blues; oranges with violets and blues; and reds with violets and greens; such as would tend to show up shade differences most readily. No browns or blacks were dyed.

The results were first of all assessed by two observers to determine how far the course of the dyeing process would be predicted from a consideration of the rate-of-dyeing data of the individual dyes. The method of doing this was to observe *(a)* the degree of compatibility and *(b)* the associated shade change in successive patterns, and to compare these results with what would be anticipated from an examination of the rate-of-dyeing constants. Some latitude was allowed in the prediction of compatibility, slight shade changes being ignored. The results of this assessment for the two observers are given in Tables VI and VII.

Borderline cases include not only those assessed as borderline by the two observers, but also those where disagreement was recorded.

The prediction of the course of dyeing was taken as justified, not justified, or borderline. Borderline cases may arise here (1) from differences in the assessment of compatibility not sufficient to allow of a verdict of "not justified," e.g. where a combination is predicted as bordering on compatibility and is actually found to be bordering on incompatibility; (2) where a combination is fairly compatible, but the shade change, although slight, is incorrect; or (3) in those anomalous cases where one component separates to some extent both at the beginning and end and should, according to prediction, separate, say, only at the beginning. As would be anticipated, some difficulties and discrepancies arose in assessing these borderline combinations, owing to the personal factor, and all cases of disagreement were put down as borderline in the assessment of compatibility. In addition, some difficulty was encountered in interpretating pairs of dyes in which the differences between the rate-of-dyeing constants were compensatory, as in Fig. 10.

The only means of assessment available here is to estimate the proportion of each constituent taken up by each successive dyeing, either by making use of the curves themselves, or by calculating the amounts from the rate-of-dyeing constants, assuming that the equation for the hyperbola fits the curve, when the amount

TABLE VI

Compatibility— Uniformity of Absorption by Cotton Limbric of the Components of Binary Mixtures as Determined Experimentally

	Chlorazol Bordeaux BS	Chlorazol Bordeaux 6B 150	Chlorazol Fast Pink BK 200	Chlorazol Fast Red F 125	Durazol Red 2B 150	Chlorazol Fast Scarlet 4BAS	Chlorazol Fast Scarlet 4B 150	Chlorazol Fast Scarlet 8B 125	Chlorazol Fast Scarlet GS	Durazol Fast Rubine B 150	Durazol Helio B 200	Chlorazol Fast Helio 2RK 200	Chlorazol Violet N 125	Durazol Fast Violet 2BS	Chlorazol Blue B 200	Chlorazol Blue G 150	Durazol Fast Blue 3R 200	Durazol Fast Blue 2R 200	Durazol Fast Blue G 200	Durazol Blue 2GN 200	Durazol Fast Blue 4GS	Durazol Fast Blue 4R 200	Chlorazol Sky Blue FF 200	Chlorazol Sky Blue GW 400	Chlorazol Steel Blue 6B 150	Chlorazol Dark Green FL 125	Chlorazol Green BN 125	Chlorazol Green GS
Durazol Fast Yellow GR 200	B	B	N	C	C	C	C	B	C	N	B	N	N	N	N	N	B	B	N	B	N	B	C	N	B			
Durazol Fast Yellow G 400	C	C	N	C	C	C	C	N	C	B	N	B	N	N	N	N	N	N	N	N	N	N	N	C	N			
Durazol Fast Yellow 6GS	B	B	N	C	B	N	N	N	C	N	N	B	B	N	N	B	N	N	N	N	N	N	N	B	N			
Chlorazol Yellow 6GS	B	C	N	N	B	N	C	N	C	N	N	B	B	N	N	B	N	N	N	N	N	N	N	B	N			
Chrysophenine G 200	N	N	N	N	B	C	N	C	C	N	N	N	N	B	N	N	N	N	N	N	N	N	N	N	C			
Durazol Fast Orange 2G 125																												
Durazol Fast Orange 4R 150																												
Chlorazol Fast Orange R 150																												
Chlorazol Orange PO 150																												
Chlorazol Bordeaux BS																												
Chlorazol Bordeaux 6B 150																												
Chlorazol Fast Pink BK 200																												
Chlorazol Fast Red F 125																												
Durazol Red 2B 150																												
Chlorazol Fast Scarlet 4BAS																												
Chlorazol Fast Scarlet 4B 150																												
Chlorazol Fast Scarlet 8B 125																												
Chlorazol Fast Scarlet GS																												
Durazol Fast Rubine B 150																												
Durazol Helio B 200																												
Chlorazol Fast Helio 2RK 200																												
Chlorazol Violet N 125																												
Durazol Fast Violet 2BS																												

C = compatible as regards uniformity of absorption. B = borderline. N = incompatible, i.e. absorption not uniform.

TABLE VII

Compatibility— Uniformity of Absorption by Cotton Limbric of the Components of Binary Mixtures as Determined Experimentally

	Chlorazol Bordeaux BS	Chlorazol Bordeaux 6B 150	Chlorazol Fast Pink BK 200	Chlorazol Fast Red F 125	Durazol Red 2B 150	Chlorazol Fast Scarlet 4BAS	Chlorazol Fast Scarlet 4B 150	Chlorazol Fast Scarlet 8B 125	Chlorazol Fast Scarlet GS	Durazol Fast Rubine B 150	Durazol Helio B 200	Chlorazol Fast Helio 2RK 200	Chlorazol Violet N 125	Durazol Fast Violet 2BS	Chlorazol Blue B 200	Chlorazol Blue G 150	Durazol Fast Blue 3R 200	Durazol Fast Blue 2R 200	Durazol Fast Blue G 200	Durazol Blue 2GN 200	Durazol Fast Blue 4GS	Durazol Fast Blue 4R 200	Chlorazol Sky Blue FF 200	Chlorazol Sky Blue GW 400	Chlorazol Steel Blue 6B 150	Chlorazol Dark Green FL 125	Chlorazol Green BN 125	Chlorazol Green GS
Durazol Fast Yellow GR 200	→	→	←	O	O	O	O	O	O	→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Durazol Fast Yellow G 400	O	O	←	O	O	O	O	O	O	→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Durazol Fast Yellow 6GS	←	←	←	O	O	O	O	O	O	→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Yellow 6GS	O	O	←	O	O	O	O	O	O	→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chrysophenine G 200	→	↑	←	→	→	O	→	O	O	→	→	→	→	→	→	→	→	→	→	O	→	→	O	→	→			
Durazol Fast Orange 2G 125										→	→	→	→	→	→	O	→	→	→	O	→	→	O	→	→			
Durazol Fast Orange 4R 150										→	→	→	→	→	→	O	→	→	→	O	→	→	O	→	→			
Chlorazol Fast Orange R 150										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Orange PO 150										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Bordeaux BS										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Bordeaux 6B 150										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Fast Pink BK 200										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Fast Red F 125										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Durazol Red 2B 150										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Fast Scarlet 4BAS										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Fast Scarlet 4B 150										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Fast Scarlet 8B 125										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Chlorazol Fast Scarlet GS										→	→	→	→	→	→	→	→	→	→	→	→	→	O	→	→			
Durazol Fast Rubine B 150											→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
Durazol Helio B 200												→	→	→	→	→	→	→	→	→	→	→	→	→	→			
Chlorazol Fast Helio 2RK 200													→	→	→	→	→	→	→	→	→	→	→	→	→			
Chlorazol Violet N 125														→	→	→	→	→	→	→	→	→	→	→	→			
Durazol Fast Violet 2BS															→	→	→	→	→	→	→	→	→	→	→			

The arrows point towards the component dyeing first, whilst O indicates that the dyes go on together. It should be noted that arrows are attached to some of the combinations rated compatible in Table VI and then indicate very slight differences in absorption.

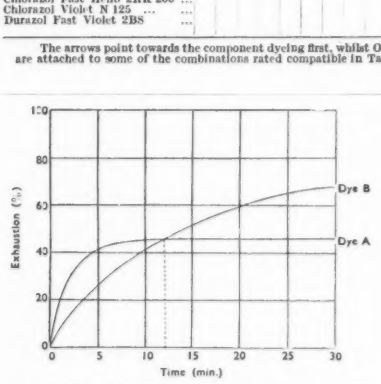


FIG. 10– Rate-of-dyeing Curves with Compensatory Constants

x taken up in time t is given by the equation—

$$x = \frac{Et}{t + t_{1/2}}$$

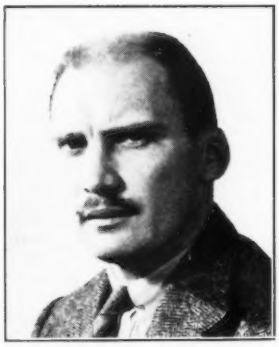
(E = the equilibrium exhaustion; and $t_{1/2}$ = the time of half-dyeing). This equation gives the proportion of each component which would be present in successive dyeings if no dye had been removed by previous dyeings. It cannot be applied to determining with any degree of accuracy the proportions of each component actually present under the practical conditions obtaining, since after the first dyeing the value of the rate-of-dyeing constants will alter with the altered concentration of the dyebath.

To be continued in the next issue.

Note: References will appear at the end of the article.

NEW PRODUCTS • TRADE NOTES

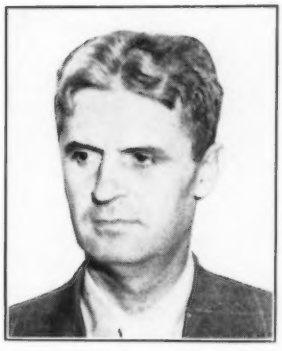
O. W. Clark



F. O. Sundstrom

H. E. Millson

W. H. Peacock



A. L. Peiker

• REORGANIZATION, CALCO DYE APPLICATION LABORATORIES

The mounting activity in the textile, paper and leather industries is mirrored in the recent announcement by the Calco Chemical Division, American Cyanamid Company, Bound Brook, N. J., of the reorganization of its Dye Application Laboratories.

A large increase in the number of inquiries that has taxed the facilities of the department, makes it necessary to consolidate the Dye Application Laboratories into three main divisions, namely; The Textile Division, the Leather, Paper and Plastic Division, and the Evaluation and Testing Division.

The direction of the work of the new divisions has been assigned to men well known in the trade for their outstanding contribution to the dye consuming industries.

Dr. A. L. Peiker has been appointed associate manager and administrative assistant to W. H. Watkins, manager of the Dye Application Laboratories.

O. W. Clark has been appointed assistant manager in charge of the cotton, viscose rayon and resin bonded pigments section of the Textile Division.

H. E. Millson has been appointed assistant manager to direct the wool, nylon, acetate and specialties section of the Textile Division.

F. O. Sundstrom has been named assistant manager of the leather and paper section, and W. H. Peacock assistant manager of the plastics and specialties section of the Leather, Paper and Plastic Division.

In the Evaluating and Testing Division, R. R. Sleeper will be in charge of new product evaluation and F. O. Dexter in charge of pigment testing and identification.

• DYESTUFFS

The current issue of *"Dyestuffs,"* quarterly publication of the National Aniline Division, Allied Chemical & Dye Corp., 40 Rector Street, New York, N. Y., contains the following articles: Notes on Dyeing of Wool and Union Materials, by D. McGowan, Jr.; Ardil, by David Traill; The Testing of Water-Repellency in Fabrics; Jute—New Uses, New Methods, by S. A. G. Caldwell; Fall 1946 Colors for Women's Gloves; The Antiseptic Properties of Surface Active Agents, by Lawrence H. Flett; Coal Tar Dyestuffs; and Dyeing and Finishing Viscose-Acetate Rayon Linings. Copies of the publication are available upon request.

• BOOKLET ON KETONES

A new booklet just published, discusses the physical and chemical properties of ten commercially important ketones produced by Carbide and Carbon Chemicals Corporation, 30 East 42nd Street, New York 17, N. Y. Specifications and shipping data are given in this booklet, as well as information regarding principal uses for these products. Ketones are important intermediates in the synthesis of industrial chemicals, and possess a high solvency for nitrocellulose and "Vinylite" resins. They are also widely used in the extraction of drugs, stripping of dyestuffs from textiles, coagulation of rubber latex, and dewaxing of lubricating oils.

A copy of this booklet may be obtained from Carbide and Carbon Chemicals Corporation. Ask for Form 4767.

• JOINS I.T.T.

Ralph W. Feil, a graduate of the University of Virginia (B.S. in Mechanical Engineering 1939), has joined the staff of the Institute of Textile Technology to work in the engineering division. Previous to his coming to the Institute he was for seven years with the Eastman Kodak Company as a quality control engineer.

• APPOINTED TO POLYTECHNIC STAFF

Dr. Thomas O'Shaughnessy, a research chemist in the pioneer research section,

Rayon Division of the E. I. Du Pont de Nemours Company in Buffalo, has been appointed Assistant Professor of Physical Chemistry at the Polytechnic Institute of Brooklyn, it has been announced by Dr. Raymond E. Kirk, dean of the graduate school and head of the Department of Chemistry.

As a new member of Polytechnic's Institute of Polymer Research, Dr. O'Shaughnessy, whose specialty is the mechanical properties of plastics in fibers, will teach courses in physical and polymer chemistry and will participate in the supervision of various research projects in Chemistry sponsored by the armed services at Polytechnic. In addition, Dr. O'Shaughnessy will supervise the work of some ten or twelve thesis students in the graduate school.

• NEW CYANAMID BULLETIN

American Cyanamid Company's Textile Resin Department has published a new bulletin on their Sheerset and Lacet resin finishes which are designed to give durable crispness and shrinkage control to all types of sheer fabrics and to Nottingham laces.

The bulletin describes the method of application and results obtained. Included are contrasting illustrations of treated and untreated lace curtains which show graphically the superior shrinkage control and stabilization of the resin treated curtains.

This aqueous resin process is said to offer one-bath finishes imparting shrinkage control, light fast and wash fast pastel colors, and durable bodying with desirable draping qualities.

Textile Finishing Bulletin No. 103, which describes Sheerset and Lacet resin finishes, is available on application to American Cyanamid Company, Textile Resin Department, Bound Brook, New Jersey.

• PLANS FOR CEGLIN SALES

John W. Little, Vice President of Sylvania Industrial Corporation, announces the resignation of C. Chester Bassett, Jr. as Manager of its Textile Finishes Division. Mr. Bassett, who has not yet revealed his future plans, played an important part in establishing the merits of "Ceglin" cellulose finishes and warp sizing in the cotton and rayon fields.

James J. Casserly and J. Andrew Clark will continue their activities in sales and service on "Ceglin," under the direction of Edwin F. James, Division Manager, who has been with Sylvania for many years and was associated with the initial development of these products.

I. Peters, who has joined the sales force of the Textile Chemical Division of Dexter Chemical Corp. and has been assigned to the New York and New Jersey area, making his headquarters at the company's general offices at 819 Edgewater Road, New York. After receiving his B.S. from City College of New York, Mr. Peters became textile chemist and colorist at Pilgrim Piece Dye Works and during the war was an instructor in the weather school of the Air Corps Technical Training Command. He later conducted research in aviation fuels and lubricants for the National Advisory Committee for Aeronautics. Since his discharge from the army, he has been a sales and manufacturing consultant in the detergent field.

Mr. James is also Vice President of Sylvan Plastics, Inc., a Sylvania subsidiary which manufactures "Sylplast" urea formaldehyde moulding materials, as well as paper and textile treating resins, waterproof adhesives, and organic soluble coatings. He is Vice President of Filatex Corporation, also controlled by Sylvania, which was formerly a leading producer of covered latex elastic yarns, and is expected to resume operations when natural rubber is released for such purposes.

• JOINS ELLICOTT LABORATORIES

Major Robert W. Little, now on terminal leave from the Army has joined the Ellicott Laboratories, Lawrenceville, New Jersey, as Director of Research. He was until recently serving with the Research and Development Branch, Office of the Quartermaster General in conducting a research program on the Flameproofing of Cotton Fabrics under the joint auspices of the Quartermaster Corps and the National Research Council of the National Academy of Sciences.

The Ellicott Laboratories produce and market chemical compositions which, it is claimed, permanently flameproof and mildewproof all kinds of fabrics.

• COLUMBIA TEXTILE COURSES

H. R. Mauersberger, director of the Evening Textile Courses for over 25 years, announces the opening of these courses at Columbia University on September 19th, 1946. A new course in "Coatings and Finishes on Fabrics" will be offered for the first time. The instructor will be Marcel Pagerie, Research Director and Tech. Advisor of Allied Textile Printers, Inc. of Paterson, N. J. It will be given on Tuesdays from 6:30 to 8:15 P.M.

There are also evening courses on Cotton, Woolen and Worsted and Rayon Manufacturing; on new synthetic textile fibers and materials; identification, analysis and testing of textile materials and Textile Chemistry. These courses are open to men and women who are interested in the subjects. All G.I. students should begin to register immediately because a large registration is expected.

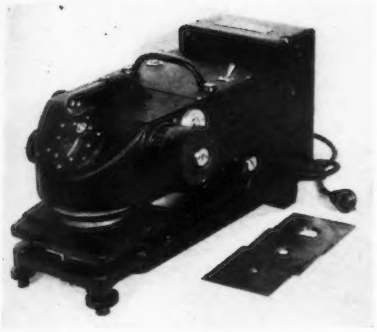
There will be a showing of textile films for all students during the winter term to which the trade is invited.

Classes are limited in size this fall and cannot be extended beyond the normal student quotas. It is advisable to register early at the Registrar's Office, East Corridor, University Hall, Columbia University, 116th Street and Broadway, New York City. For further information and free folder on these courses, write or phone H. R. Mauersberger, 303 Fifth Avenue, New York 16, N. Y., MUrray Hill 4-1159, or the registrar of the University.

• GURLEY PERMEOMETER

W. & L. E. Gurley, Troy, N. Y., have announced a new Permeometer for the measurement of air permeability of textile fabrics, very porous paper, and other porous sheet materials. It differs from other apparatus in that it operates as a pneumatic bridge, with results not noticeably affected by motor speed variations or other variables. It conforms to ASTM Method D737 (Tentative Method of Test for Air Permeability of Textile Fabrics). It is stated that it will test most cloth in which air permeability is important.

The use of the Permeometer is analagous to the use of the Wheatstone bridge for measuring electric resistance. A suction fan exhausts air from a reservoir. Voltage, speed and air flow variations have very little effect on the suction in the reservoir which is maintained by a gravity-actuated relief valve at 10 inches of water. Air is drawn from the atmosphere through two parallel chambers into the reservoir. In one of these, the reference chamber, a suction of 0.5 inches of water is maintained by standard stainless steel inlet and outlet orifices. In the other, the test chamber, the suction is determined by the sample under test, held in clamping rings, and by a calibrated flow meter valve. This valve,



The Gurley Permeometer.

operated by turning a micrometer head, is adjusted until the suction in the test chamber balances the suction in the reference chamber, as indicated by zero reading of the vane in a variometer connecting the two chambers. The valve reading is then a measure of the air permeability of the sample. The micrometer valve reading can be converted into air permeability by reference to a calibration curve or table.

It is stated that the Permeometer requires no special skill to use and routine tests may be made in not more than 15 seconds.

• HENRY EYRING FELLOWSHIP

The Textile Research Institute, which appointed its first post-graduate fellowship in scientific textile research in October 1944, now has eleven fellowships with the latest one announced as "The Textile Research Institute Henry Eyring Fellowship in Scientific Textile Research," according to a statement made by Mr. H. Wickliffe Rose of the American Viscose Corp. and Chairman of the Board of Directors of the Institute.

Dr. Eyring has been the Director of Research for the Textile Foundation at Princeton, New Jersey, for the past two years, and in that capacity has supervised the research studies of nine of the Institute fellows appointed under him and enrolled in the Princeton University Graduate School. As professor of physical chemistry with Princeton University since 1936, he has established both a national and international reputation as a physical chemist.

Dr. Eyring's new post is with the University of Utah as Dean of the Graduate School, and it is to be in that position that he received the establishment of the Institute's latest fellowship.

• ANNUAL MEETING, N.A.C.M.

The Annual Meeting of the National Association of Cotton Manufacturers will be held at The Copley-Plaza, Boston, Massachusetts, on Thursday, October third.

Present plans are for an informal luncheon at noon, followed by a business session and a speaking program in the afternoon, and a banquet in the evening.

Dr. Manfred T. Hoffman, who has announced the opening of an office as a textile consulting engineer for the hat, felt and wool trade at 187 High Street, Newburyport, Mass. The phone number is 1912. Dr. Hoffman will specialize in modern wool cleaning equipment and the development of improved machinery and methods for the manufacture of fine grade fur and wool qualities. He has had twenty years of experience as technical director and research manager of leading hat concerns.

• NEW GERMAN REPORTS

An ultraviolet lamp for detecting streaks and smears in printed textiles is described in a report on the German textile printing industry, now on sale by the Office of Technical Services, Department of Commerce. New methods of finishing rayon, research on synthetic fibers, and viscose research in Germany are described in three other reports, also on sale by OTS.

The report on textile printing (PB-27730; photostat, $5; microfilm, $2; 67 pages, including illustrations) was prepared by Elliot Broadbent, consultant in the Office of the Quartermaster General.

The "Flu-Tex" ultraviolet lamp, developed by the Quartz Lamp Co. of Hanover in cooperation with the I. G. Farbenindustrie, has been used successfully in detecting doctor streaks as well as facing of backgrounds in textile printing, according to Mr. Broadbent. The print shows up so well that the slightest scratch or snap is visible.

Other I. G. Farben products for textile printing include two new "Rapidogen" developers, one for screen printing and one for roller printing. Use of these developers for printing "Rapidogens" on synthetics is said to result in much greater smoothness.

The I. G. Farben product "Anthrasol Salt NO," used chiefly in the dyeing of "Indigosol" grounds and plain dyes, has found some favor in Germany. The salt prevents over-nitrozation of the "Indigosol."

"Coloresin V extra" was developed by I. G. Farben as a wartime substitute for starch and gum thickener. It has proved to be so satisfactory that German printers are continuing to use it, despite its relatively high cost.

I. G. Farben's new "vat acid" process for vat color application is described in a report on German methods for finishing rayon fabrics (PB-27732; photostat, $5; microfilm, $2; 73 pages, including illustrations). The report was prepared by Glenn D. Jackson, Jr., consultant in the Office of the Quartermaster General.

The new process involves preparing a solution of the pigment vat with caustic soda in the usual way and then acidifying the sodium leuco. When fabrics are padded with this solution, the finely divided "vat acid" penetrates more completely than when the cloth is padded with larger pigments or regular leuco vats. The resulting color is said to be very level and free from streaks and shading.

The report describes methods used for dyeing viscose, acetate rayon, perlon, knit goods, and other materials.

German development work on a wool-like rayon staple fiber is described briefly in Report PB-22434 (photostat, $1; microfilm, 50 cents; 5 pages), prepared by Daniel B. Wicker and Julian F. Smith for the Joint Intelligence Objectives Agency. Experiments in shrinkproofing staple fiber with aliphatic diisocyanates in solution in benzene, a process for cyclic pulping and viscose production, and other phases of synthetic fiber research also are described briefly in the report.

Wartime German research on the problem of reducing alkali and acid consumption in rayon tire cord production without sacrificing quality is discussed in Report PB-22433 (Photostat, $1; microfilm, 50 cents; 3 pages), written by Lyman E. Fourt and Julian F. Smith for the Joint Intelligence Objectives Agency. The research was carried out at Vereinigte Glanzstoff, near Berlin, in the Russian zone.

Orders for the reports should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C., and should be accompanied by check or money order, payable to the Treasurer of the United States.

• CHICAGO OFFICE, CALCO PIGMENTS

The Calco Chemical Division, American

Cyanamid Company, Bound Brook, N. J., announces that the new office of the Chicago Branch of their Pigment Department, is now at 228 North LaSalle St., Chicago 1, Illinois.

Gerald J. Boyer, Kenneth A. Coate and Paul J. Cuenot will make their offices at this address.

• PAISLEY ACQUIRES ADHESIVE DIVISION

Murray Stempel, Vice President and General Manager, Paisley Products, Inc., Chicago, Illinois, has announced that his firm has purchased the Adhesive Division of Certified Products Company, located at 2624 West Taylor Street, Chicago, Illinois. The purchase includes all formulas, manufacturing processes, raw materials and finished products. The purchase price and financial details were not disclosed. No processing machinery was included as Paisley plans to transfer all manufacturing to their modern plant, which is now undergoing extensive interior alterations to expand production facilities.

• GENERAL MANAGER, RAYON DIVISION, CELANESE

R. C. Jones has been appointed general manager of the rayon division of Celanese Corporation of America to fill the post vacated by John E. Bassill, who is retiring from the company on September 1. Mr. Jones, a former vice president of Tubize Rayon Corporation, was associated with that company for more than 25 years.

• DCAT MEMBERSHIP

"The Drug, Chemical and Allied Trades Section of the New York Board of Trade now has a membership of over 700 for the first time in its history," according to Lloyd I. Volckening, Chairman of the Section's Membership Committee (president, The Ivers-Lee Company), who points out that of this number 70 firms have become affiliated with DCAT within the past four months.

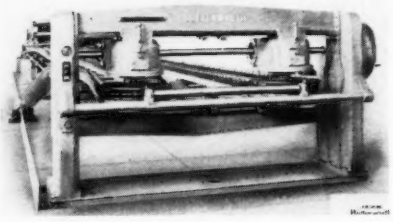
• HIGH POLYMER COMMITTEE

The Du Pont Company has announced that Dr. C. Lalor Burdick has returned from a year's duties in Mexico City and will head a special "High Polymer Committee" to study and coordinate Du Pont research and manufacturing activities concerned with such materials as nylon, plastics, and similar polymeric compounds.

In April, 1945, Dr. Burdick, then special assistant to W. S. Carpenter, Jr. president of Du Pont, was elected chairman of the boards of Cia. Mexicana de Explosivos, which operates a commercial dynamite plant in Mexico, and Du Pont S. A., general sales organization for Du Pont products in Mexico. In these positions he will be succeeded by Robert W. Johnson as chairman of the board of Du Pont S. A., and William A. Denker as chairman of the board of the explosives company. Both are already officials of these companies.

Dr. Burdick joined the Du Pont Company in 1928 as assistant chemical director of the Ammonia Department.

• NEW BUTTERWORTH TENTER



Shown above is the Butterworth Mercerizing Tenter with Overhead Drive which was described on page 380 of our July 29th issue. The photo shown with the item in the July 29th issue illustrated a Butterworth High-Speed Tenter. The new drive permits speeds up to 100 yards per minute for mercerizing.

• MELLON INSTITUTE BOOKLET

Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa., has recently published a booklet entitled "From the Research Laboratory to the Armed Forces." It consists of a series of talks, broadcast by station WCAE, in which the participating specialists described the essential research programs headed by them and gave summaries of the results. The contents are described by the following titles: Research in the Conquest of Malaria, by R. Stuart Tipson; Research Improves Resistors for Radio and Radar, by Edward E. Marbaker; The Triumph of Synthetic Rubbers, by Charles F. Winans; Maintaining Workers Health in the Industries, by John F. McMahon; Science Solves Pressing Textile Problems, by Jules Labarthe, Jr.; and Good Strokes in Life Preserver Research by E. Gray King. Copies are available without charge upon request to the Institute.

• SHARPLES CHEMICALS BOOKLET

Sharples Chemicals, Inc., 123 South Broad Street, Philadelphia 9, Pa., have recently issued a booklet entitled "Sharples Synthetic Organic Chemicals" which lists their commercial products and many products now in the semi-commercial or laboratory stage of development. Over 150 chemicals are described. Sharples produces alcohols, alkyl chlorides, substituted amides, amines, dithiocarbamic acid derivatives, ethers, esters, hydrocarbons, mercaptans, organic sulfides, phenols and substituted ureas. Copies of the booklet are available upon request.

• A.I.C. AWARD

Ward Vinton Evans will receive the 1946 Honorary Scroll Award of the American Institute of Chemists at a dinner meeting of the Chicago Chapter on October 4. The program will include:

"Ward Evans—My Friend and Colleague"
by Dr. Franklyn B. Snyder

"Ward Evans—Teacher, Scientist and Citizen"
by Dr. Gustav Egloff

Presentation of Honorary Scroll
by Dr. C. A. Johnson

Acceptance Address
by Dr. Ward V. Evans

Professor Evans is being honored for his outstanding achievements in the field of chemistry as a great teacher, as an industrial consultant, and for his high civic spirit.

A national authority on explosives, Professor Evans retired from Northwestern University where he was Chairman of the chemistry department in 1945 after having been a member of the faculty since 1916. For the past year he has been associated with the Army University in Europe. During World War I, he served as an expert for the United States Bureau of Mines in the testing of high explosives.

• THIRD NYLON PLANT

A third plant for manufacturing nylon yarn will be built at an estimated cost of approximately $20,000,000 on a 600-acre tract near Chattanooga, Tenn., it has been announced by E. I. du Pont de Nemours & Company. Approximately 18 months will be required for completion. About 1,000 people will be needed to operate the plant in the beginning.

"This expansion," said R. A. Ramsdell, manager of the company's Nylon Division, "plus expansions now under way at present plants, will triple today's output of nylon textile fibers."

SANDOZ PRESENTS *the color achievement of the month*

Baby Blue BY NORTH STAR

Fashions never change in baby colors, but the *quality* of the colors is ever-improving. North Star's "Iris"—a fine, snuggle-soft baby blanket—benefits from recent technical advancements in dyes and chemicals that provide new efficiency in dyeing, new trueness and fastness of color.

Firms like North Star Woolen Mill Company and its subsidiary, The Lima Woolen Mills Company, depend upon Sandoz among their suppliers for the finest quality in colors. They have learned from experience that Sandoz' policy of *thinking ahead with textiles* is profitable to *them* in terms of economical handling, sales appeal, customer satisfaction.

For example: Sandoz' Fast-to-Light Milling Colors, such as Brilliant Alizarine Milling Blue BL (Pat.) or its range of Metomega Chrome Colors to which has just been added Metomega Chrome Green BLL (Pat. applied for), exceptionally fast and level dyeing.

For acid, chrome or direct dyes . . . or auxiliary chemicals . . . for both natural and synthetic fibres . . . be guided by the successful "color achievements" you have been seeing in these Sandoz advertisements. Sandoz application laboratories are located in New York, Boston, Philadelphia, Los Angeles, Charlotte, Toronto, where stocks in wide range are carried. Other branches in Chicago, Paterson and Providence.

SANDOZ CHEMICAL WORKS, INC., 61 VAN DAM STREET, NEW YORK 13, N. Y.

SANDOZ *thinks ahead with textiles*

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Manufacturers of

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TEXTILE OILS
STRIPPING COMPOUNDS

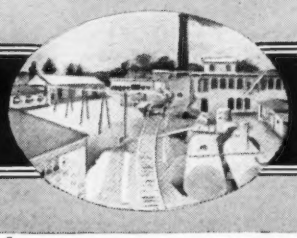
CALEX CRYSTALS

(Calgon Agglomerated)

For years this outstanding product has assisted mills in obtaining peak production in the dyeing and finishing operations.

INSTANTLY SOLUBLE, it saves labor when today labor costs are a chief factor in the ultimate price of a fabric.

For treating pulled wool, hard water conditions, and as a soap saver, CALEX CRYSTALS has no equal.



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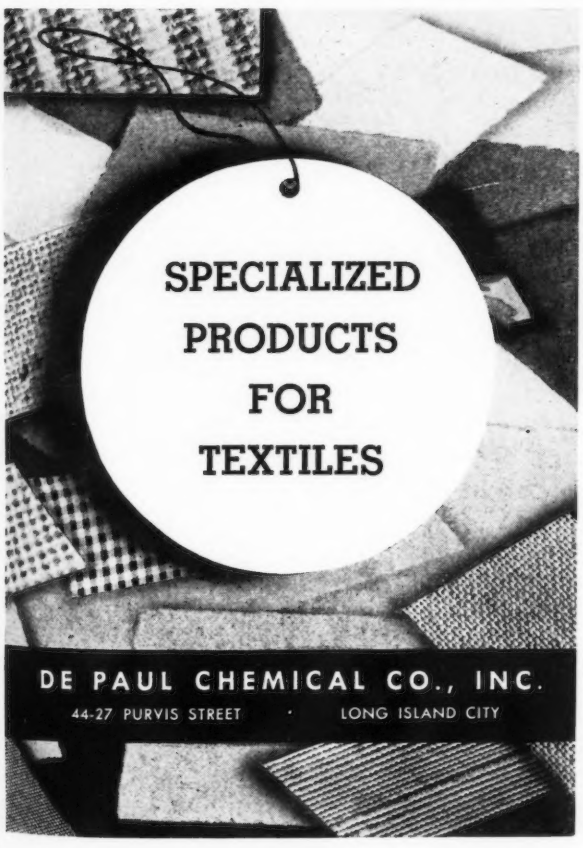
MASS.

WATSON-PARK COMPANY
261 FRANKLIN STREET · BOSTON, MASS.



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RAYCO *"Cellophane Spangles"*

For flock printing that will "spark" novelty fabrics

Both white and color dot or design effects are obtainable with "Spangles." The sparkling brilliance is quite unusual, and gives you a new sales approach. Handled like flock.

Request sample of "Spangles"

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QUALITY RICHMOND PRODUCTS

Something Really NEW for WOOL and WORSTED

Scours either neutral or acid
Contains NO Soap
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The newest idea for
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VIRGINIA SODIUM HYDROSULFITE

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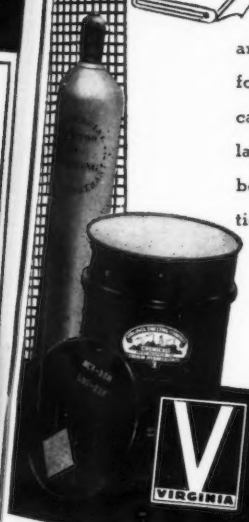

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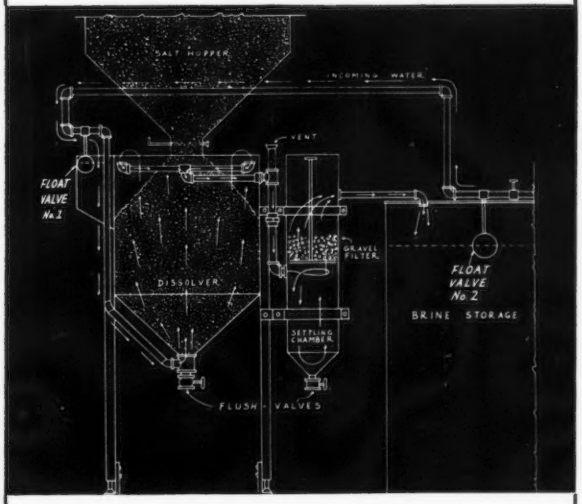

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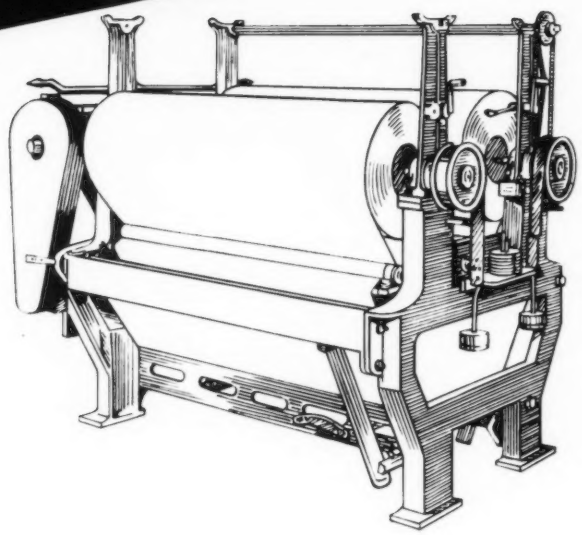

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